A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

SEPTEMBER, 1935.

GENERAL PHYSICS.

ADSORPTION.

3706. Chemisorption on Charcoal. A. King. *Chem. Soc., J. pp.* 889–894, *July,* 1935.—It has been found that the pH of suspensions of sugar charcoal varies with the temperature of activation of the charcoal. The surface conditions leading to a constant pH are established on charcoal when activated for a short time at a low temperature, but not until after 8 hours at high temperatures. Similar results were obtained with graphite and commercial charcoals; in the latter case the adsorption of acids and bases was shown to vary with the pH. The acid condition of the surface due to low-temperature activation was stable, whereas a high-temperature basic charcoal gradually reverted to the acid condition on standing in air. CO_2 activations gave similar results to those with O_2. Reasons for the variation of the pH of charcoal suspensions with temperature of activation are discussed. [See Abstract 523 (1935).] AUTHOR.

3707. Adsorption of Dilute Organic Vapours by Active Carbon. A. Akermann. *Comptes Rendus,* 201. *pp.* 210–212, *July* 16, 1935.—The volume as liquid of such vapours adsorbed by charcoal when this is saturated is approximately constant, unless the adsorbed substance undergoes chemical action in contact therewith, when less is adsorbed. Within limits a similar rule applies as regards the point at which adsorption ceases to be complete, this limit varying with the rate of adsorption and being much reduced if the C is moist. The degree and rate of desorption when clean air is passed over saturated C is very variable. [See Abstract 3958 (1934).] C. A. S.

See also Abstracts 3725, 3940.

ATOMIC AND MOLECULAR STRUCTURE.

3708. Cross-Section of Heavy Nuclei for Slow Neutrons. J. H. van Vleck. *Phys. Rev.* 48. *pp.* 367–372, *Aug.* 15, 1935.—The cross-section for slow neutrons is computed with the statistical model of the nucleus and neutron-proton interaction of the Majorana form. The constants in the potential are taken from Feenberg's calculations on the binding energies of light nuclei. It is rather surprising that the scattering problem is reducible to one-particle form despite the fact that the Majorana operators permute the coordinates of neutrons and protons. The formulæ for the cross-section are applicable even when there is neutron-neutron interaction, as suggested by L. Young, provided a simple change is made in the constants. It is shown that the anomalously large cross-sections in Cd and Hg cannot be interpreted on the basis of an additional node of the neutron's wave function within the nucleus for Hg as compared with Cd. AUTHOR.

3709. Radiative Capture of Protons by Carbon. G. Breit and F. L. Yost. *Phys. Rev.* 48. *pp.* 203–210, *Aug.* 1, 1935.—The theoretical yield in the reaction $^{12}C + {}^{1}H \rightarrow {}^{13}N + \gamma$ is some 1000 times the observed. This probably indicates that this reaction should not be represented by a potential function constant inside and Coulombian outside ^{12}C. The potential must be changed so as to decrease the region in which the initial and final wave functions overlap, or this region be shifted towards smaller radii. The calculated γ-ray yield for ^{9}Be + ^{1}H increases with voltage more slowly than the observed, indicating a deeper nuclear "well." Application of the method of complex eigenvalues to the properties of wave functions near resonance is discussed. C. A. S.

3710. Carbon Radioactivity and Other Resonance Transmutations by Protons. L. R. Hafstad and M. A. Tuve. *Phys. Rev.* 48. *pp.* 306–315, *Aug.* 15, 1935.—By observations with d.c. potentials of from 200 to 900 kV and currents of protons and deutons up to 10μA, it is shown that: (1) the induced radioactivity from the reaction (C + H^1) is produced by a resonance process with two resonance lines at about 400 and 480 kV indicated, whereas the efficiency of the corresponding process for (C + D^2) increases approximately exponentially throughout the voltage range covered; (2) the γ-rays emitted in the reaction (Li + H^1) show resonances at 450 kV and 850 kV; (3) the γ-rays from (F + H^1) suggest resonances at 320, 700 and 800 kV; (4) the γ-rays from (Be + H^1) do not appear to be produced by a resonance process. AUTHORS.

3711. Correlation of Nuclear Disintegration Processes. Robley D. Evans and M. S. Livingston. *Rev. Modern Physics*, 7. *pp.* 229–236, *July*, 1935.—Charts and tables indicate all fully and probably established nuclear reactions reported up to April 29, 1935. In the tables A–2Z for each isotope is plotted against Z, and all nuclear transformations resulting naturally or by bombardment are shown graphically. In all 140 (in one Table 141) established and 67 doubtful, unconfirmed, or incompletely studied reactions (naturally radioactive nuclei in the U, Th, and Ac series are omitted) are classified into 13 (in one Table 14) types of reaction, and various predictions are made, *e.g.*, that the following should occur: $^{12}_{6}\mathrm{C} + \alpha \rightarrow n + ^{15}_{8}\mathrm{O} \rightarrow n + ^{15}_{7}\mathrm{N} + e^{+}$; $^{12}_{6}\mathrm{C} + p \rightarrow ^{13}_{7}\mathrm{N} + \gamma$; $^{25}_{12}\mathrm{Mg}\,(^{29}_{14}\mathrm{Si}, ^{33}_{16}\mathrm{S}) + d \rightarrow n + ^{26}_{13}\mathrm{Al}\,(^{30}_{15}\mathrm{P}, ^{34}_{17}\mathrm{Cl}) \rightarrow n + ^{26}_{12}\mathrm{Mg}\,(^{30}_{14}\mathrm{Si}, ^{34}_{16}\mathrm{S}) + e^{+}$. C. A. S.

3712. Artificial Disintegration. P. Savel. *Ann. de Physique*, 4. *pp.* 88–136, *July–Aug.*, 1935.—Describes a method for studying the γ-rays and neutrons emitted by light elements under excitation by Po α-particles. A high pressure chamber, filled with argon or hydrogen at 25 atmospheres, was used, the former for investigating γ-rays and the latter for neutrons. The γ-radiation from Li, F, Na and Mg seemed, from absorption measurements in Pb, to be homogeneous, but two components were indicated in the case of Al. N was found to emit γ-rays. The excitation of γ-rays increases regularly with α-particle energy, in the case of F, but for Mg and Al a sudden increase occurs as the α particle range approaches 3·8 cm. Li, F, Na, Mg and Al, but not N, were found to emit neutrons. The origin of the γ-rays and neutrons is discussed and an account of the determination of the number of disintegrations per bombarding α-particle is given. W. E. P.

3713. Disintegration of Boron by Neutrons. H. J. Taylor. *Phys. Soc., Proc.* 47. *pp.* 873–876, *Sept.* 1, 1935.—The tracks of the particles which result from the disintegration of B by neutrons have been recorded by impregnating the emulsion of a photographic plate with borax. It is shown that there are two modes of disintegration, corresponding to the reactions: $B^{10} + n^{1} \rightarrow Li^{7} + He^{4}$, $B^{10} + n^{1} \rightarrow He^{4} + He^{4} + He^{3}$. Photomicrographs of the tracks, showing both modes of disintegration, are reproduced. AUTHOR.

3714. Artificial Radioactivity Produced by Irradiation of Gold with Neutrons. I. Kurtschatow and G. Latyschew. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 652–655, 1935.—A gold foil 10 × 2 × 0·01 cm. was irradiated for 17 h. with neutrons from a Rd-Be source immersed in water. On presenting the foil to an expansion chamber, 2000 expansions gave tracks of only 5 heavy particles. About 10 electron tracks, however, were observed on each expansion and it is therefore concluded that there is little evidence for disintegration with the emission of heavy particles. The β- and γ-ray activity were also examined with a Geiger counter and the half-value period estimated at 3 days compared with 2·5 days found by previous workers. No evidence was obtained of a γ-radiation due to a nuclear disintegration of half-period 5 hr. as reported by Sosnowski and Preiswerk [see Abstracts 1319 and 1895 (1935)]. The observed γ-radiation had a half-period of 3 days and measurements with Pb absorbers gave a mean energy of 3 × 10^5 eV. It is possible that the discrepancy is due to the use of different neutron sources and this point is undergoing further examination. F. C. C.

3715. Non-Observance of Induced β-Radioactivity with the Light Elements. H. J. Walke. *Phil. Mag.* 20. *pp.* 266–274, *Aug.,* 1935.—Reasons are given for attributing the non-observance of induced β-radioactivity with elements lighter than F to their stable nuclear structure and their isotopic constitution. F. C. C.

3716. Attempts to Detect γ-Radiation by Impact of α-Particles on Heavy Elements. W. B. Lewis and B. V. Bowden. *Phil. Mag.* 20. *pp.* 294–304, *Aug.,* 1935.—Three different methods are described for the detection of hard γ-radiation excited by impact of α-particles (from Rn and RaC^1) on Pb or Sn. None was detected within the limits of one quanta per 12,000 α-particles from RaC^1 or 50,000 from Rn. Slater's results are therefore again not confirmed [see also Abstract 1583 (1931)]. The observations may also mean that not more than one pair of positive and negative electrons are produced per 10,000 α-particles from RaC^1 or per 10^5 from Rn. C. A. S.

3717. Electrolytic Separation of the Hydrogen Isotopes. O. Halpern and P. Gross. *J. Chem. Phys.* 3. *pp.* 452–456, *Aug.,* 1935.—Starting from the hypothesis that the rate-determining process in the electrolysis of gases is constituted by the recombination of the gas atoms on the electrode, a formula is developed which expresses the separation coefficient as a function of well-known thermodynamic constants of H and D compounds and of the frequencies with which the atoms carry out their thermal oscillations on the electrode. The formula gives a certain range for the value of the separation coefficient which is in good agreement with the observations. As a by-product of these calculations a relation is established between the normal electrode potentials of H and D.
AUTHORS.

3718. Neutron Scattering in Water and Lead. M. Deisenroth-Myssowsky, I. Kurtschatow, G. Latyschew and L. Myssowsky. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 656–669, 1935. *In German.*—By determination of the relative numbers of recoil protons projected from a plate of paraffin wax screened with different thicknesses of Al at different parts, stretched across an expansion chamber and subjected to neutron bombardment, the velocity spectrum of the incident neutron beam was examined. Observations were first made with thicknesses up to 20 cm. of water between neutron source (Rd–Be) and chamber. A regular decrease in the number of protons occurred with increasing thickness of filter and screens, indicating that the general character of the spectrum remained unchanged. It was found on closer examination, however, that after a large correction for neutron scattering, the results showed that in agreement with previous workers, the effective cross-section of neutrons for protons increased with decreasing energy of the neutrons. With a Pb filter, the effective cross-section remained fairly constant as the thickness was increased from 12 to 30 cm. The effect is explained and correlated with previous results by Bonner on the assumption that the beam of neutrons is heterogeneous and that the effective cross-section first increases and then decreases with increasing energy of the neutrons. A few very long-range particles which penetrated 0·3 mm. of brass corresponding to a range of 330 cm. in air at N.T.P. were observed. F. C. C.

***3719. Interaction of Neutrons with Matter. J. R. Dunning, G. B. Pegram, G. A. Fink and D. P. Mitchell.** *Phys. Rev.* 48. *pp.* 265–280, *Aug.* 1, 1935.—Of fast neutrons (from Rn + Be) approximately 10 % of those colliding with nuclei are captured, 90 % elastically scattered. Slow neutrons (of energy $< 10^5$ eV), are very largely absorbed by 0·5 mm. of Cd, and are captured by 1 mm. of Li with ejection of ionising particles. This enables them to be separated and counted. Production of slow neutrons by collision of fast neutrons with H is a maximum for about 10 cm. H_2O or paraffin; D_2O is only about 1/5·5 as effective. Temperature variation (95°–373° K) has very little effect ($\ngtr$ 5 %) as regards slow neutrons. Absorption of Cd is nearly exponential. Neutron-nucleus cross-section for fast neutrons increases fairly regularly with atomic weight; for slow neutrons (72 elements examined) it varied from slightly less (*e.g.* for Al, S) to several thousand times greater (Gd, Sm, Cd). Compared to Cu $<$ 1 % of slow neutrons from Cd are elastically scattered. Several new types of apparatus are figured. C. A. S.

3720. Periodic Groups of Non-Hydride Di-Atoms. C. H. D. Clark. *Faraday Soc., Trans.* 31. *pp.* 1017–1035, *Aug.*, 1935.—A method of classification of non-hydride di-atoms into periods (determined by non-bonding groups of electrons) and into groups and sub-groups (dependent on electrons derived from the incomplete systems of the constituent atoms) is described. Isosteres (or isotopic molecules) are sub-divided for di-atoms into three sets, for which the names orthosteres, metasteres and parasteres are proposed. Advantages and applications of this procedure are described. Various regularities and progressions of spectroscopic constants are traced through different groups and periods of di-atoms, and methods of forming estimates of numbers undetermined experimentally are explained. Ways in which the proposed method may throw light on problems of valency and bond strength are also suggested. A table is presented showing 1485 di-atoms in their appropriate periods and groups. AUTHOR.

3721. Electronic Structures of Polyatomic Molecules. Part VII. Ammonia and Water Type Molecules and Their Derivatives. R. S. Mulliken. *J. Chem. Phys.* 3. *pp.* 506–514, *Aug.*, 1935.—Spectroscopic and ionisation potential data are used in obtaining electron configurations in terms of molecular orbitals for NH_3, PH_3, H_2O, H_2S and their derivatives, *e.g.*, CH_3NH_2, $(CH_3)_2NH$, N_2H_4, H_2O_2, CH_3OH, NH_2Cl, ClOH, Cl_2O. These electron configurations hold for molecules in their normal states, but can be used in predicting the energy of "vertically" excited states, *i.e.*, energies corresponding to nuclear dimensions the same as for the normal state. Estimates of vertical ionisation potentials for the various orbitals used are given. The longest wave-length ultra-violet spectra and minimum ionisation potential are attributed in the NH_3 derivatives to excitation of a nearly non-bonding electron of the N atom, in the H_2O and H_2S derivatives to excitation of a non-bonding O or S atom electron. [For Part VI see Abstract 3242 (1935)]. AUTHOR.

3722. Electronic Structures of Polyatomic Molecules. Part VIII. Ionisation Potentials. R. S. Mulliken. *J. Chem. Phys.* 3. *pp.* 514–517, *Aug.*, 1935.—Observed and predicted values for ionisation potentials of non-bonding electrons are compared, and the differences attributed mainly to charge-transfer effects. Multiplet interval and other criteria are cited as evidence that assumed non-bonding orbitals are really such, *i.e.*, that they are effectively localised and interact little with other orbitals. The prediction of ionisation potentials for bonding and anti-bonding electrons is also discussed. The present paper grows, in part, from suggestions of Price [see Abstract 2565 (1935)] as to the effects of dipole fields on ionisation potentials. AUTHOR.

3723. Electronic Structures of Polyatomic Molecules. Part IX. Methane, Ethane, Ethylene, Acetylene. R. S. Mulliken. *J. Chem. Phys.* 3. *pp.* 517–528, *Aug.*, 1935.—Electron configurations for the normal states of C_2H_6, C_2H_4, and C_2H_2 are given, and are used in interpreting observed ionisation potentials. Excited orbitals of CH_4 and the others are also discussed and tentative interpretations given for the ultra-violet spectra. "Reduced" interatomic distances are studied as a measure of overlapping and resonance of orbitals of different atoms or radicals. AUTHOR.

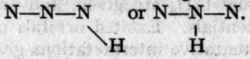
3724. Quantum Theory of Valence. J. H. van Vleck and A. Sherman. *Rev. Modern Physics*, 7. *pp.* 167–228, *July*, 1935.—General features are discussed, the object of the paper being the consideration of the two main methods of approximation now in vogue, *viz.* (1) that of molecular orbitals, developed by Lennard-Jones, Hund, Herzberg and Mulliken, and (2) the strictly homopolar method of Heitler, London, Slater and Pauling. It is concluded that both procedures are none too good approximations and that confidence can only be placed in their results when in agreement. Both theories predict a nearly right-angled model for water, a tetrahedron for methane, and other geometrical configurations for C and N compounds, while both schemes furnish an understanding of the stereochemistry and magnetic behaviour of the transition groups, and of the resonance energies in aliphatic and aromatic compounds. Divergences are pointed out, but the method of molecular orbitals is considered to have the greater computational possibilities. H. H. Ho.

3725. Spin-Isomerisation of Hydrogen at Paramagnetic and Diamagnetic Surfaces. H. S. Taylor and H. Diamond. *Am. Chem. Soc., J.* 57. *pp.* 1251–1255, *July*, 1935.—Rapid low-temperature ortho-para hydrogen interconversion is obtained on surfaces paramagnetic in nature having large capacities for van der Waals adsorption. Paramagnetic metals, oxides and salts may be used to produce such surfaces. Decrease in either magnetic susceptibility or in adsorptive capacity reduces the velocity of low temperature interconversion. A slow conversion at liquid air temperatures on catalysts diamagnetic in bulk, such as Ag and ZnO, may be due either to paramagnetism of surface atoms or to a residual low-temperature adsorption of the activated type. Rapid high-temperature conversion associated with activated adsorption has been confirmed.

A new high temperature conversion mechanism involving an exchange reaction with water has been demonstrated, and the possibility of other similar exchange conversions has been indicated. AUTHORS.

3726. Structure of Benzene and Methyl Derivatives. P. L. F. Jones. *Faraday Soc., Trans.* 31. *pp.* 1036–1039, *Aug.*, 1935.—The vapours of hexamethyl benzene, mesitylene, *p*-xylene and benzene have been examined by the electron diffraction method. Theoretical curves constructed, using the interatomic separations given, and assuming a plane molecule with a regular hexagonal structure for the benzene nucleus, have their maxima and minima at points agreeing well with those determined experimentally. AUTHOR.

3727. Geometrical Structure of the N_3H Molecule. G. Herzberg, F. Patat and H. Verleger. *Zeits. f. Elektrochem.* 41. *pp.* 522–524, *Aug.*, 1935.—The rotation-vibration spectrum of gaseous N_3H is investigated with large dispersion in the infra-red. A very strong band at 1·045μ and a fairly weak one at 0·808μ are found. The fine structure of the bands indicates that the three N atoms lie practically in a straight line and that, at least in a considerable number of molecules, the H atom does not lie on the same line, so that the geometrical structure is either



It is not altogether certain but highly probable that in some of the molecules the H atom lies in the same line as the N atoms and hence that two different modifications of N_3H exist. J. E. K.

3728. Structure of the Ozone Molecule and Its Bands in the Infra-Red. G. Hettner, R. Pohlman and H. J. Schumacher. *Zeits. f. Elektrochem.* 41. *pp.* 524–525; *Disc.*, 526, *Aug.*, 1935.—The spectrum of ozone of over 98 % purity is investigated from the visible up to 27μ in the infra-red. It is found that bands at 11·38μ and 7·6μ which have previously been ascribed to O_3, the latter as its fundamental frequency, do not belong to O_3 but to nitrogen oxides. The long wave fundamental frequency lies at 14·1μ with two maxima at 14·4μ and 13·8μ; in addition there are absorption maxima at 4·75μ and 9·65μ. Various possible molecular structures are examined and it is concluded that the most plausible O_3 model is one in which the atoms are arranged as a central force system at the corners of an acute angled triangle with vertical angle of about 19·5° and fundamental frequencies corresponding with the three most intense bands at wave-lengths 4·51, 9·65 and 14·1μ. The force constant of the base atoms is 5·3 times as large as that between base and vertex atoms. J. E. K.

3729. Constitution and Properties of Aromatic and Unsaturated Compounds. E. Hückel. *J. de Physique et le Radium*, 6. *pp.* 347–358, *Aug.*, 1935.—A connected account of much previous work showing the inapplicability of the classical theory of valency or of quantum-mechanical treatment based on Heitler and London's method for explaining the definite direction of valency forces and the peculiar nature of aromatic compounds. A consistent explanation results from the author's method, based on classification of the electrons into those with antisymmetrical (π) and symmetrical (σ) eigenfunctions, and calculation of the coupling of the π electrons (which alone are of importance). Of these C_6H_6 has six each with its eigenfunction extending through the whole molecule, thus explaining the equivalence of the bonds, and similarly for other ring compounds. The only parameter required is the resonance integral. In this way the energies of aromatic and unsaturated molecules, the existence of free radicals such as CPh_3, and results of substitution and relative amounts formed of the *o*, *m* and *p* derivatives are explained. C. A. S.

3730. Constitution of Water in Solutions of Weak Electrolytes. C. S. S. Rao. *Phil. Mag.* 20. *pp.* 310–322, *Aug.*, 1935.—The Raman water-band in formic and acetic acid solutions gets sharper and shifts to larger frequency with increasing concentration of the dissolved substance, the smaller frequency branch of its intensity curve at the same time changing from convex to concave in its form. When studied at the same concentration, the band in acetic acid solution is sharper than, and shifted to the side of greater frequency as compared with, that for the solution of formic acid ; but, when the water-content in the two solutions is equalised these differences are less conspicuous. The above results are discussed in relation to change in water equilibrium and hydration, and the close similarity between the results herein obtained and those observed with strong electrolytes [see Abstract 3246 (1935)] is pointed out. AUTHOR.

***3731. Molecular Weight Analysis by the Svedberg Ultracentrifuge. W. D. Lansing and E. O. Kraemer.** *Am. Chem. Soc., J.* 57. *pp.* 1369–1377, *July*, 1935.—The theory for the determination of average molecular weights for mixtures has been developed and the need for distinguishing various kinds of " averages " has been discussed. It has been shown how number-average, weight-average, and Z-average molecular weights may be calculated from data on sedimentation equilibrium in the Svedberg ultracentrifuge, and the methods have been applied to experimental data on gelatin. A numerical measure for the non-uniformity of mixtures with respect to molecular weight has been proposed. The significance of the results in connection with macromolecular materials, such as cellulose, rubber, proteins, etc., has been explained and the correct method for comparing molecular weights by osmotic pressure or equivalent methods and Staudinger's viscosity method has been elucidated. AUTHORS.

See also Abstracts **3775, 3782, 3823, 3824, 3825, 3851, 3870, 3891, 3894, 3897, 3933, 3970, 3999.**

COLLOIDS.

3732. Preparation of Colloidal Solutions by Silent Electric Discharges. Part III. S. Miyamoto. *Kolloid Zeits.* 71. *pp.* 297–300, *June*, 1935.—The methods previously employed for the preparation of the sols of Au, Ag, Pt, Pd, As, Sb and Hg are now used for the preparation of hydrosols of MnO_2, Te and alcosols of Se and Te. The stability of these sols is investigated. [For Part II see Abstract 27 (1935).] J. K.

3733. Electrokinetic Potential and the Stability of Colloids. H. Mueller. *J. Phys. Chem.* 39. *pp.* 743–747, *June*, 1935.—Mathematical and experimental considerations are given to the origin and nature of the protecting skin assumed to exist around every colloidal particle, according to March. The proposed theory is shown to explain the dependence of the stability of hydrophobic colloids on the electrokinetic potential. J. K.

***3734. Supersonic Pulveriser. B. Claus.** *Zeits. f. techn. Physik*, 16. 7. *pp.* 202–205, 1935.—Describes the construction of a pulveriser which makes use of the property of piezo-quartz plates to produce oscillations, two parallel quartz plates being used and tuned to the same wave-length. The apparatus is dealt with under the oscillator, the transferer, the producer and the method of assembly. Finally, methods of use are considered, dealing with the two possibilities of direct and indirect pulverising. [See also Abstracts 2350 and 2976 (1935).] R. C. F.

See also Abstract 3731.

CRYSTAL STRUCTURE AND PROPERTIES.

3735. Structure of Nickel-Cobalt Alloys. W. Broniewski and W. Pietrek. *Comptes Rendus*, 201. *pp.* 206–208, *July* 16, 1935.—The alloys were prepared *in vacuo*, annealed for 24 hr. at 800° and cooled slowly. Curves relate composition to conductivity and thermoelectric power relative to Pb and their temperature co-efficients, Curie point, dilatation, Brinell hardness, loss due to hysteresis, and coefficient of magnetisation. No compound is indicated, but some of the curves indicate a breach of continuity at about 75 % Co, up to which percentage the alloys appear to be solid solutions of Co γ in Ni α, above that of Ni α in CoH. C. A. S.

3736. Size and Arrangement of Bismuth Microcrystals Formed from Vapour. C. T. Lane. *Phys. Rev.* 48. *pp.* 193–198, *Aug.* 1, 1935. —The magneto-resistance of films of Bi, deposited on glass and mica, has been measured at room- and liquid-air temperatures and for various angles between the film normal and the magnetic field (H = 16,000). The ratio $\Delta R_{-180^\circ C.}/\Delta R_{+20^\circ C.}$ rises steeply for thicknesses between $0\cdot1\ \mu$ and $0\cdot4\ \mu$ and then much more gradually to a thickness of $4\ \mu$. The thermal coefficient of resistance shows no corresponding anomaly. X-ray analysis shows all the films to be composed principally of small crystals with (111) parallel to the backing. ΔR varies with the direction of H, the current remaining always in one direction in the film, as predicted, from experiments on monocrystals for such an assembly. The bearing of these results on the structure of metallic films is briefly discussed. AUTHOR.

3737. Structure and Composition of Rhombic Cobalt Silicide. B. Borén, S. Ståhl and A. Westgren. *Zeits. f. phys. Chem.* 29. *Abt.B.* 4. *pp.* 231–235, 1935.—Edge lengths of the unit cell are, $a = 7\cdot095$, $b = 4\cdot908$, $c = 3{,}730$ Å. Space group V_h^{16}. The Si atoms form zig-zag chains along the c-axis, analogously to the structures of FeB and Cr_3C_2. F. I. G. R.

3738. Structure of Potassium Persulphate, $K_2S_2O_8$. R. C. Keen. *Zeits. f. Krist.* 91. *pp.* 129–135, *Aug.*, 1935. *In English.*—The structure of potassium persulphate was examined in order to compare the structure of the persulphate group in this crystal with that found in other compounds. It was found that the cell was triclinic and had the dimensions: $a = 5\cdot10$ Å, $b = 6\cdot83$ Å, $c = 5\cdot40$ Å, $\alpha = 106^\circ\ 54'$, $\beta = 90^\circ\ 10''$, $\gamma = 102^\circ\ 35'$. The space group was found to be $C'_i(P_1)$. The structure may be given by the following parameters:

	KH	O_1	O_2	O_3	O_4	S
x	± 67°	± 31°	± 110°	± 192°	± 77°	± 93°
y	± 70°	± 32°	± 82°	± 82°	± 162°	± 87°
z	± 185°	± 25°	± 107°	± 35°	± 40°	± 7°

In the lattice each K atom is surrounded by ten O atoms at an average distance of 3.08 Å. Two S atoms and eight O atoms are grouped together in the S_2O_8 group. The distance between the two O atoms forming the bond in the S_2O_8 group was found to be $\cdot140$ Å. The distance between S atoms in the same persulphate group is 3·86 Å. The average S to O distance in a SO_4 tetrahedron was found to be 1·51 Å. AUTHOR.

3739. Effect of Temperature on Lattice Constants of MnO. Barbara Ruhemann. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 590–607, 1935. *In German.*—Debye patterns with large angles of deflection are obtained for MnO at temperatures from 77° Abs. to room-temperature with an accuracy of ± 0·5 X.U. The lattice spacing at 210° Abs. is 4·4335 Å and the coefficient of expansion down to 175° Abs. is constant at $1{\cdot}45 \times 10^{-5}$. At 115·9° Abs. an anomaly appears similar to that obtained in the case of NH_4Br. From 116° to 77° Abs. the spacing is practically constant at 4·4258 Å, and in addition a spacing of 4·416 Å is present. Both spacings are in equilibrium, but the former decreases in intensity as the temperature falls. An explanation is suggested. H. J. H. S.

3740. Structure of Nickel Sulphate Heptahydrate $NiSO_4$, 7 H_2O. C. A. Beevers and C. M. Schwartz. *Zeits. f. Krist.* 91. *pp.* 157–169, *Aug.*, 1935. *In English.*—The x and y parameters of Ni and S in the crystal $NiSO_4{\cdot}7H_2O$ are derived by means of (a) replacement of Ni by Mg, (b) a Patterson synthesis. These are used for two-dimensional Fourier syntheses which give all the parameters to a fair approximation. The structure has SO_4 groups and octahedral groups of six H_2O around Ni, and an extra water molecule. The water molecules are of two types, and the coordination group contains both types exactly as in the lower hydrate $NiSO_4{\cdot}6H_2O$. AUTHORS.

3741. Structure of $Rh(NH_3)_5Cl)Cl_2$. C. D. West. *Zeits f. Krist.* 91. *pp.* 181–186, *Aug.*, 1935. *In English.*—The structure of the isomorphous orthorhombic pentammines $R(NH_3)_5X)Y_2$, where R is Cr, Co, Rh or Ir, and X and Y are halogens, is a distortion of the cubic structure of the hexammines $R(NH_3)_6Y_2$. The complete structure determination of $Rh(NH_3)_5Cl)Cl_2$ shows that $a = 13{\cdot}32$, $b = 6{\cdot}71$, $c = 10{\cdot}42$, $Z = 4$ and that Rh, Cl_1 and N_{I-III} atoms are on symmetry planes $uv0$, while Cl_{II} and N_{IV} are in general positions xyz of space group V_h^{16}. The sixteen parameters are specified. The structure is in agreement with observed properties of the crystals. AUTHOR.

3742. Lattice-Dimensions of ZnO. C. W. Bunn. *Phys. Soc., Proc.* 47. *pp.* 835–842, *Sept.* 1, 1935.—The lattice-dimensions of pure ZnO condensed from the smoke have been determined to a high degree of accuracy by means of X-ray powder photographs. Bradley and Jay's lattice-dimensions of quartz and Siegbahn's X-ray wave-lengths being accepted as standards, the lattice-dimensions of ZnO at 18° C. are found to be: $a_0 = 3{\cdot}2426_5 \pm 0{\cdot}0001$; $c_0 = 5{\cdot}1948 \pm 0{\cdot}0003$; axial ratio $c_0/a_0 = 1{\cdot}6020_0 \pm 0{\cdot}0001$. Both the lattice-dimensions themselves and the axial ratio are lower than Finch and Wilman's electro-diffraction values [see Abstract 3109 (1934)] which are based on the X-ray lattice-dimension of gold, by amounts larger than the combined errors of both methods. There are thus real discrepancies, which are of the order of 0·5 to 1 %. In view of these discrepancies, Finch and Wilman's assumption that the apparent lattice-dimension of gold is the same for 40–60 kV electrons as for X-rays, may not be correct. The discrepancies therefore represent the combined possible discrepancies shown by gold and zinc oxide. This does not apply to the axial ratio, which is independent of any reference substance. The difference between the axial ratios determined by electrons and by X-rays appears to point to a real difference in axial ratio between the surface and the interior of ZnO crystals. AUTHOR.

3743. Magnetic Anisotropy and Crystal-Structure of 1·2; 5·6-Dibenzanthracene. K. S. Krishnan and S. Banerjee. *Zeits. f. Krist.* 91. *pp.* 173–180, *Aug.,* 1935. *In English.*—An account is given of some magnetic measurements on crystals of 1·2; 5·6-dibenzanthracene, of both the monoclinic and the orthorhombic varieties. A simple and convenient method of measuring the susceptibilities of very small crystals is described. The magnetic data are discussed in relation to the structure of the crystals, and the probable orientations of the molecules in the unit cell are deduced from the magnetic data. It is thus found that in the monoclinic crystal the lengths of the molecules are perpendicular to the (001) plane, and the molecular planes are inclined at $+ 25°$ and $- 25°$ respectively to (010). In the orthorhombic crystal, the lengths of the molecules are along the b axis, and the molecular planes are inclined at $\pm 29°$ to the (001) plane. The optical data for the crystals, and the observed polarisation of the absorption bands, are in conformity with the molecular orientations suggested. AUTHORS.

3744. Crystal Structure of Pyrene. J. Dhar and A. C. Guha. *Zeits. f. Krist.* 91. *pp.* 123–128, *Aug.,* 1935. *In English.*—The paper gives an account of the X-ray study of the structure of the pyrene crystal by the well-known rotation and oscillation methods. The crystal belongs to the monoclinic prismatic class; the dimensions of the unit cell are $a = 13 \cdot 74$ Å; $b = 9 \cdot 22$ Å; $c = 8 \cdot 45$ Å; $\beta = 102\frac{1}{2}°$, and there are 4 molecules in the unit cell. The crystal is assigned to the space group C_{2h}^5 $(P\ 2_1/a)$. On the basis of the X-ray data some tentative inferences are drawn regarding the orientations of the pyrene molecules in the crystal. AUTHORS.

3745. Structure of the Sugars. Part I. Simple Sugars and Glucosides. E. G. Cox, T. H. Goodwin and (Miss) A. I. Wagstaff. *Chem. Soc., J. pp.* 978–982, *July,* 1935.—From the chemical point of view, the OH attached to the first C atom (reducing group) in a sugar molecule is sharply differentiated from the remaining OH groups. The data now available render it highly probable that this first C atom and its attached group possess also special significance from a geometrical point of view. Replacement of one group in the molecule by another of different size usually necessitates complete readjustment of the relative positions of the OH groups and therefore of the molecules themselves. In the present case, however, it appears that the hydroxylic linking is only two-dimensional, the molecules being linked together in sheets, the thickness of which may be changed appreciably without otherwise altering the structure.

T. H. P.

3746. X-Ray Analysis of the Structure of Iridescent Shells. S. R. Swamy. *Indian Acad. Sci., Proc.* 1*A. pp.* 871–878, *June,* 1935.—X-ray diffraction patterns of the nacreous layer of iridescent shells have been obtained using a monochromatic X-ray beam incident along various directions. From a study of these patterns it is found that the nacreous layers of all the shells consist of aragonite crystals orientated with their c axes normal to the surface. But the orientations of the other two axes vary with the particular kind of shell examined. For instance, the ab plane is randomly orientated in *Trochus* and *Turbo.* In *Nautilus* evidence for twinning is found combined with a specific orientation of the ab plane. The ab planes of the crystals in *Mytilus viridis* and *Margaratifera vulgaris* are found to exhibit specific orientation with respect to the lines of growth. The error in orientation is also much smaller than in *Nautilus pompilius.*

The results obtained closely correspond with the optical observations of Raman [see Abstract 3841 (1935).] AUTHOR.

3747. Mechanical Twin Formation in Calcite. Part I. D. B. Gogoberidze and E. G. Ananiaschwili. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 547–552, 1935. *In German.*—Rotation angle conserved : the lattice being completely rotated. The Laue spots are unchanged, with no brushes. The crystal faces along the twinning plane are partly distorted. F. I. G. R.

3748. Growth of a Deformed Crystal and Recovery Processes. M. Kornfeld. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 608–618, 1935. *In German.*—The factors affecting the growth of a deformed crystal are considered with particular reference to Al crystals, followed by a discussion of the author's and other workers' results on the processes involved in recovery. H. J. H. S.

3749. Crystal Form in Equilibrium and Growth. I. N. Stranski and R. Kaischew. *Ann. d. Physik,* 23. 4. *pp.* 330–338, *July,* 1935.—A quantitative treatment of the problem of crystal equilibrium and crystalline form during growth is now given based upon the work of Volmer, who has introduced the idea of the two-dimensional nucleus (embryo) and thereby derived an expression for the nuclear formation velocity, and that of Kossel and Stranski, who utilise the work of separating single surfaces for deriving the arrangement and separation processes of the elementary units. The purely thermodynamic method of Gibbs-Wulff is also discussed in connection with the problem. H. H. Ho.

3750. Theory of Light Absorption in Heteropolar Crystals. D. Blochinzew. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 639–651, 1935. *In German.*—This theory is based on a consideration of the free mobility of the spaces (Löcher) and of the electrons arising on absorption of the light quanta. Theoretically, with heteropolar crystals absorption bands appear whose width does not depend on the temperature. This conclusion appears to agree with certain observations by Hilsch and Pohl [see Abstract 1920 (1928)]. T. H. P.

3751. Unipolar Conduction in the Interior of Crystals. R. Deaglio. *Accad. Sci. Torino, Atti,* 70. 3. *pp.* 331–336, 1934–1935. Experiments are made on the electrical conductivity of carborundum crystals, (1) with one surface natural and the opposite surface cut flat, (2) with both surfaces cut flat and parallel ; plane gold electrodes are used. In case (1) the ampere-volt curve is confined to one quadrant thus showing perfect unipolar conduction ; in this condition the crystal exhibited no electrolytic polarisation but showed the blocking-layer effect in its photoelectric properties. Conversely in case (2) the ampere-volt curve was symmetrical with respect to the axes and had a point of inflection at the origin ; neither electrolytic polarisation nor the blocking-layer effect was observed. Further experiments showed that the phenomena were independent of the nature of the electrodes. Photographs of some of the crystals used are reproduced. F. C. C.

3752. Optical Determination of Elastic Constants of Crystals. C. Schaefer and L. Bergmann. *Accad. Lincei, Atti.* 21. *pp.* 701–702, *May* 19, 1935.—The diffraction figures previously observed [see Abstract 3666 [1934)] are dependent on the elastic properties of the crystal and on the direction of the rays passing, but are independent of the form of the crystal and of the type of excitation. It is now shown that such figures form a simple means of determining crystal elastic constants. T. H. P.

3753. Absorption Factor for Powder and Rotating Crystal Methods of X-Ray Crystal Analysis. A. J. Bradley. *Phys. Soc., Proc.* 47. *pp.* 879–899, *Sept.*, 1935.—A method has been devised for calculating the absorption factor for the powder method. It may be used for all values of μr, where μ is the linear absorption coefficient and r the radius of the specimen. It is, however, especially suitable when μr exceeds 2. For smaller values of μr, for which the calculations are tedious and become less accurate, it is better to use Claasen's graphical method. By such a combination of the two methods a set of data was calculated for which the absorption factor may easily be obtained for any value of μr and for any angle of reflection, with an error not exceeding 1 %. The data may also be applied for the calculation of the absorption factor in the lines belonging to the layer of zero order in rotation photographs. AUTHOR.

See also Abstracts 3782, 3841, 3916, 3924, 3926, 3927, 3946, 3974, 3977, 4004, 4036.

DENSITY.

See Abstracts 3933, 3980.

DIFFUSION AND OSMOSIS.

3754. Diffusion Equation. B. I. Davydov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 476–478, *June*, 1935. *In German.*—In deriving the ordinary diffusion equation, $\delta w/\delta t = D\delta^2 w/\delta x^2$ (1), the velocity with which the particles move between two impacts is taken as infinitely great. The diffusion coefficient may be expressed in terms of the free path ξ and its mean duration τ as follows : $D = \overline{\xi^2}/2\tau = \bar{\xi}^2/\tau = c^2\tau$, where c is the mean velocity of the particles. In the limiting case, when $c^2 \to \infty$, $\tau \to 0$, equation (1) is obtained. The velocity of the particles may be taken into account by considering the mean time between two impacts. The problem is worked out mathematically for two-dimensional space by means of two functions, representing the probabilities that a particle has the velocity c or $-c$ with regard to the x axis. The method cannot be generalised to apply to the three-dimensional case. T. H. P.

***3755. Kinetic Interpretation of Osmotic Pressure. M. v. Stackelberg.** *Zeits. f. Elektrochem.* 41. *pp.* 615–617, 1935.—The action of the semi-permeable membrane of an osmotic cell is interpreted as follows. An aperture in the membrane and a molecule of the solute are regarded as forming together a kind of valve, past which the solvent molecules are forced by a pumping action. A simple apparatus illustrating this action is described. T. H. P.

ELASTICITY AND PLASTICITY.

3756. Theory of Draw Springs. H. Bock. *Zeits. f. Instrumentenk,* 55. *pp.* 255–262, *June*, 1935.—For relatively thin springs, with little rotation, and without spring barrels the laws of bending give the equation $M = EJ\phi/l$ where M is the moment of rotation of the spring, E the elasticity, J the moment of inertia of the transverse section, l the length and ϕ the rotation. In the paper a theory is developed for the rotation of springs by which the frictional relations of the spring are explained. The problem is idealised by assuming (1) a linear distribution of the extension over the section, (2) tension in the outer fibres within the elastic limits,

(3) the spiral rotation to be circular, and (4) the effect of the spring barrel, at the centre, negligible compared with the length of the spring. R. S. R.

3757. Elastic Stability of a Rectangular Plate When Subjected to a Variable Edge Thrust. D. M. A. Leggett. *Cambridge Phil. Soc., Proc.* 31. *pp.* 368–381, *July*, 1935.—The stability of a rectangular plate subjected to constant thrust over opposite pairs of edges and subjected to various boundary conditions has been previously discussed. Here, the stability of a rectangular plate whose sides, in terms of ordinary rectangular axes, ξ, η, have equations $\xi = \pm a$, $\eta = \pm b$, and which is subjected to a thrust $K\xi$ over the edges $\eta = \pm b$, is discussed. J. S. G. T.

3758. Determination of Young's Modulus for Building Materials by a Vibration Method. G. Grime. *Phil. Mag.* 20. *pp.* 304–310, *Aug.*, 1935.—The longitudinal vibration excited in a specimen by tapping one end is recorded photographically with the aid of a kathode-ray oscillograph, and its frequency is determined by comparison with a superimposed time-scale. Young's modulus E is then calculated from the expression $E = 4l^2n^2p$, connecting length l, frequency n, and density p. AUTHOR.

***3759. Manufacture of Helical Silica Springs. A. King, C. G. Lawson, J. S. Tapp and G. H. Watson.** *Journ. Sci. Instruments*, 12. *pp.* 249–252, *Aug.*, 1935.—A machine for automatically winding fine helical silica springs is described, and also an apparatus for mechanically drawing the fibres from which the springs are made. Details of procedure are given, together with a table showing the sensitivity of typical springs. Some uses of these springs are suggested. AUTHORS.

See also Abstracts 3810, 3816.

GRAVITATION.

3760. Absolute Definition of the Period of Pendular Oscillations. L. Laboccetta. *Accad. Lincei, Atti*, 21. *pp.* 661–665, *May* 5, 1935.—Since the equation $T = 2\pi\sqrt{l/g}$ for a simple pendulum does not show how g is affected by the mass and density of the attracting sphere, the equation is developed according to the known laws of gravity and a table drawn up in which the density, mass and gravitation at the surface of the sphere are demonstrated in terms of the radius of the sphere. H. M. B.

3761. Thermal Equilibrium in a General Gravitational Field. R. C. Tolman. *Nat. Accad. Sci., Proc.* 21. *pp.* 321–326, *June*, 1935.—The author has previously determined for the special case of static gravitational fields the conditions for thermal equilibrium and the investigation is extended here to the case of any gravitational field. The investigation leads to an apparently satisfactory covariant expression. For the local freely falling observer, for whom gravitational effects have been abolished, the equations show that he will find a temperature-gradient oppositely directed to the acceleration which he observes for the medium, and in accordance with the principle that all forms of energy have inertia, he will interpret this as the necessary condition to prevent heat from "lagging behind" in the accelerated medium. The expression obtained may be useful for non-homogeneous cosmological models with thermal flow from one portion to another. R. S. R.

See also Abstract 3804.

HYDRODYNAMICS AND AERODYNAMICS.

3762. Forces on Two Circular Cylinders Placed in Uniform Flow. Part II. D. Endô. *Phys. Math. Soc. Japan, Proc.* 17. *pp.*

194–217, *Jan.*, 1935. *In English.*—By modifying the bipolar transformation used by Lagally, the complex velocity potential is obtained for the irrotational motion of an incompressible perfect fluid in the outer region of two parallel circular cylinders when the constants of circulation round them are given and the flow at infinity is uniform. The resultant pressures and forces on the cylinders are calculated by using the Blasius formula. It is shown that the Kutta-Joukowski theorem holds also for the vectorial sum of the forces acting on them. The forces on the cylinders are shown to be equal in magnitude and opposite in sense when either the uniform flow or the circulatory one is present. The case when the distance of the cylinders is large compared with their radii is worked out. The forces are calculated numerically for a few cases, and some practical applications of the problem are given. [For Part I see Abstract 4043 (1934).]
G. F. P. T.

3763. Vorticity-Transport Theory of Turbulent Motion. S. Goldstein. *Cambridge Phil. Soc., Proc.* 31. *pp.* 351–359, *July*, 1935.—The general case of three-dimensional motion in Taylor's vorticity-transport theory of turbulent motion [see Abstract 3087 (1932)] is discussed.
J. S. G. T.

See also Abstracts **3811, 3813, 3820, 3941, 3958.**

KINETIC THEORY OF MATTER.

3764. Effective Cross-Section of He Compared with He$^+$. F. Wolf. *Ann. d. Physik,* 23. 4. *pp.* 285–303, *July*, 1935.—The effective cross-section of He compared with He$^+$ ions decreases linearly with increasing potential, beginning at about 60 cm.^{2}/cm.^{3} for velocities of about 20 V and falling to about 35 cm.^{2}/cm.^{3} for 980 V. The effective cross-section of He compared with H_2^+ is smaller (6·4 cm.^{2}/cm.^{3} at 220 V compared with 50 cm.^{2}/cm.^{3} for He$^+$ ions). It is shown that the variation of effective cross-section with potential is in accord with theory and with the results of previous workers when certain considerations have been taken into account.
H. J. H. S.

3765. Effective Collision Cross-Sections of the Alkali Atoms in Various Gases. S. Rosin and I. I. Rabi. *Phys. Rev.* 48. *pp.* 373–379, *Aug.* 15, 1935.—The mean free paths and effective collision cross-sections of neutral atoms of Li, Na, K, Rb and Cs were measured in H_2, D_2, He, Ne and A by the method of molecular beams. The beams were sufficiently narrow and the scattering gas was confined to a region sufficiently small that a resolution of one minute of arc was attained. The results show a larger collision cross-section in D_2 than in H_2 for all the alkalies with the exception of Li. This effect is interpreted as a consequence of the smaller spacing of the D_2 rotational levels. The results in general are in qualitative agreement with the quantum theory of collisions.
AUTHOR.

3766. Possibility of Determining the State of Degeneration of a Gas. M. Satô. *Tôhoku Univ., Sci. and Technol. Reports,* 24. *pp.* 26–29, *May*, 1935. *In German.*—The possibility of determining the degree of degeneration of a gas from considerations relating to translatory Brownian motion, based on the Bose-Einstein statistical theory, is investigated. In the case discussed the magnitude of the Brownian motion is found to be rather less than that calculated in accordance with classical theory. [See Abstract 470 (1934).]
J. S. G. T.

See also Abstract **3973.**

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

3767. Spheroidal Functions of the Second Kind. J. A. Stratton. *Nat. Acad. Sci., Proc.* 21. *pp.* 316–321, *June,* 1935.—In an earlier paper [see Abstract 1430 (1935)] a solution of the general equation was obtained in the form of an expansion. This expansion diverges in general at the branch points $z = \pm 1$ and consequently is usable only for large values of the independent variable. In the present paper a second solution is obtained, valid in the neighbourhood of $z = 0$, and its analytic connections with the earlier functions are determined. R. S. R.

3768. Statistical Theory of Errors. N. Campbell. *Phys. Soc., Proc.* 47. *pp.* 800–809, *Sept.* 1, 1935.—It is maintained that the adjustment of observations is *not* a statistical problem. It is argued that there is no proof that the conditions necessary for a statistical theory of errors exist and that the process of adjustment adopted by experimenters can be justified apart from statistical considerations. The conclusions thus attained are reviewed. The actual argument cannot be summarised.

AUTHOR.

3769. Fundamental Mechanical Magnitudes. G. Georgi. *Accad. Lincei, Atti,* 21. *pp.* 612–614, *May* 5, 1935.—The expression of the dimensions of so-called derived physical quantities in terms of certain fundamental physical dimensions, such as mass, length and time, is purely a matter of practical convenience. It is more correct to say that there are as many fundamental dimensions as there are different kinds of magnitudes to be measured, and velocity, for example, is really just as fundamental a magnitude as length or time. The modern tendency is to increase rather than diminish the number of fundamental magnitudes, because the fewer we take the number of our fundamental magnitudes to be the more likely are we to confuse dimensionally quantities with quite different physical characters. A. J. McC.

See also Abstract 3932.

MECHANICS, CLASSICAL.

3770. Present Knowledge of Orbits in the Three-Body Problem. E. Strömgren. *Bull. Astronomique,* 9. 2. *pp.* 87–130, 1934.—Two equal masses trace out, with constant speed, circular orbits around their common centre of gravity, and a third infinitesimal mass is projected in a given manner and moves in the gravitational field of the other two. The orbits of the latter mass are calculated by numerical integrations, classified, and a specimen figure of each type of orbit given. Many types of periodic orbits are described. Axes moving with the two finite masses are employed throughout. G. C. McV.

***3771. High-Speed Tops and Gyroscopes. R. C. Colwell and N. I. Hall.** *Rev. Sci. Instruments,* 6. *pp.* 238–241, *Aug.,* 1935.—A method is described by which with an electric spinner speeds of 10^5 r.p.m. can be obtained. A metal top is placed in a rotating magnetic field, the spinning torque being supplied by the reaction of the magnetic field on the currents induced in the top. The major difficulties arise from excessive vibration, choice of suitable materials to withstand the high speeds, and, especially, air resistance. The top spinner and the electrical driving arrangements are shown in a diagram. Equations are developed for the motion of the top. R. S. R.

See also Abstracts 3760, 3788, 3789, 3790, 4021.

MECHANICS, QUANTUM.

3772. Property of de Broglie's Operator *H*. **R. L. Gomes.** *Accad. Lincei, Atti,* 21. *pp.* 499–501, *April* 7, 1935.—The double square of de Broglie's operator *H* is equal to the product of the square of this operator and the square of Dirac's operator. From this result there follows immediately the relation $E^2/c^2 = p^2 + (2\mu_0)^2c^2$, connecting the energy E and the momentum *p* of a plane wave. A. J. McC.

3773. Dirac Vector Model for Multiplet Spectra. M. Markow. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 553–564, 1935. *In German.*—For equivalent electrons the Hamiltonian function assumes the form $H = \Sigma a_K F_K$ where the quantities a_K are polynomials of the scalar product of the orbital moments and the quantities F_K are integrals over the radial parts of the wave functions. This form of the Hamiltonian permits a simple solution of the secular determinants for M = O, S = O which embraces all energy levels of the given problem. The cases of equivalent *p* and *d* electrons are given as an example. The possibility of generalising the theory so as to apply to an arbitrary electron configuration is examined. J. E. K.

3774. Sommerfeld Fine Structure Constant. H. Ertel. *Zeits. f. Physik,* 95. 11–12. *pp.* 775–777, *July* 12, 1935.—Born's theory of the electron [see Abstract 487 (1934)] is applied to the deduction of the Sommerfeld fine structure constant α. The calculation provides the value $\alpha^{-1} = 137\cdot302$ which agrees with the observed value $137\cdot298$ within the limits of exactitude of the determinations of *h* and *e*. J. E. K.

3775. Some Properties of Dipole and Quadripole Radiation from Nuclei. H. M. Taylor. *Cambridge Phil. Soc., Proc.* 31. *pp.* 407–415, *July,* 1935.—Assuming a spinless radiating particle moving in the centrally symmetrical field in a nucleus of radius of the order of 10^{-12} cm. a wave-mechanical calculation is made of the types of radiation emitted when the particle changes its azimuthal quantum number by 2, 1 or 0. It is shown that when the dipole moment of the nucleus vanishes the potentials radiated are the same as those radiated when the dipole moment does not vanish except for the difference in the numerical factor which governs the intensity. It is further shown in detail that of all the possible transitions of the type $\Delta l = 2$ or 0 certain ones give rise to specially simple radiated potentials which may be considered as arising from a classical vibrating quadripole and that the remainder give rise to radiated potentials which may be obtained by superposition of the fields of suitably oriented quadripoles. The importance of the results to the theory of internal conversion of γ-rays is discussed. J. E. K.

See also Abstracts 3724, 3766, 3973, 3999.

RELATIVITY AND ETHER.

3776. Einstein's Gravitational Equations for Dynamical Universes with Complete Central Symmetry. C. Tolotti. *Accad. Lincei, Atti,* 21. *pp.* 488–492, *April* 7, 1935.—Assuming that the universe is completely symmetrical round a fixed centre and that the propagation of light is isotropic, the coordinates of space-time can be chosen so that its line-element is an orthogonal quadratic form of a simple type. The author obtains the Einstein field-equations of such a universe in terms of these coordinates. [See following Abstract.] A. J. McC.

3777. Typical Case of a Dynamical Universe with Complete Central Symmetry. C. Tolotti. *Accad. Lincei, Atti,* 21. *pp.* 572–575, *April* 28, 1935.—In a previous note [see preceding Abstract] the author obtained the field-equations of a universe with complete symmetry round a given point. If the additional assumption is made that the velocity of light is isotropic and independent of position in any coordinate frame bound to the moving matter, it is found that the universe must be completely homogeneous. A. J. McC.

SOLUTION.

3778. Absorption of Hydrogen Chloride by Organic Liquids. S. Hamai. *Chem. Soc. Japan, Bull.* 10. *pp.* 207–211, *June,* 1935. *In English.*—The absorption of HCl into 1,1,2-trichlorethane and pentachlorethane at 20°, 15° and 12° C. has been measured and the heats of absorption have been calculated. The solubilities, including those mentioned in a previous paper [see Abstract 1460 (1935)], are in the order of the total bond energies of these substances. AUTHOR.

3779. Solubility of Noble Gases in Aqueous Salt Solutions. G. Åkerlöf. *Am. Chem. Soc., J.* 57. *pp.* 1196–1201, *July,* 1935.—The solubility of He and A in various salt solutions at 25° has been studied. The salting out constants obtained have been found to have the same order of magnitude as those of any other non-electrolyte studied. A short discussion of the salting out studies that have been presented in the literature shows the need for an investigation of real precision. AUTHOR.

3780. Solubility of Non-Electrolytes. Part II. Free Energy of Hydration of Aliphatic Compounds. J. A. V. Butler and C. N. Ramchandani. *Chem. Soc., J. pp.* 952–955, *July,* 1935.—The free energy of hydration of some aliphatic amines, acids, nitriles, and esters has been determined, and it is shown that, in simple compounds, this quantity is an approximately additive function of the groups present. The nature of the interaction between the solutes and water is discussed, and values are derived of the additive interaction constants of various groups with water. [For Part I see Abstract 1744 (1935).] AUTHORS.

3781. Dissociation of Solid Al-Mg Solutions. M. I. Zacharowa and W. K. Tschikin. *Zeits. f. Physik,* 95. 11–12. *pp.* 769–774, *July* 12, 1935.—Describes the determination, by X-ray methods, of the limiting solubility of Al in Mg and the investigation of the rate of dissociation in the case of Al/Mg alloys which have received different thermal treatments. The limiting solubility of Al in Mg at 150°, 218° and 300° C. is found to be 2·0 %, 3·3 % and 6·2 % by weight. The rate of dissociation at these temperatures is shown to be dependent to a marked extent on the previous history of the alloy. W. E. P.

See also Abstracts 3730, 3944.

SURFACE TENSION AND COHESION.

3782. Theory of the Alkali-Metals. P. Gombás. *Zeits. f. Physik,* 95. 9–10. *pp.* 687–691, *July* 1, 1935.—In an earlier publication [see Abstract 2869 (1935)] the author has shown that bonding in the alkali metals can be explained by means of a simplified metallic model, and that the most important constants of these metals can thereby be evaluated. The method was previously applied to potassium and it is now shown that better results can be acquired from a new calculation of the Coulomb reciprocal effect energy between the positive ionic lattice and the negative electronic gas, together with some further considerations. The following values are respectively obtained for the lattice constant, lattice energy, and compressibility of potassium: $\delta_0 = 5\cdot43$ Å, $U = 112\cdot4$ k.cal./mol., $k = 2\cdot6 \times 10^{-11}$ cm.^{2}/dyne, compared with the experimental results: $\delta_0 = 5\cdot15$ Å, $U = 126\cdot2$ k.cal./mol., $k = 2\cdot0 \times 10^{-11}$ cm.^{2}/dyne. H. H. Ho.

3783. The Eötvös Constant. D. G. Dervichian. *Comptes Rendus,* 201. *pp.* 130–133, *July* 8, 1935.—In a previous paper [see Abstract 3327 (1935)] the author has defined surface tension as representing the work necessary to separate two surfaces of area 1 cm.^{2} in the body of the liquid. This work is approximately calculated with the aid of van der Waals' internal pressure and an empirical relation $\rho \log \rho/\rho^1 = (C/T_c)(T_c - T \pm \epsilon)$ where ρ and ρ^1 are the density of the liquid and its saturated vapour at temperature T, and ϵ is small. An approximate expression for K in Eötvös' equation is thus derived. K has been calculated for the substances for which data are available. K is between 8 and 10 for most substances not containing polarised groups. In view of the approximations made in the calculations the divergence from the experimental value 2 is not regarded as unsatisfactory. Substances containing polarised groups yield yet higher values of K. This is explained on the basis of anisotropy in the interaction of the molecules. P. H. B.

See also Abstracts 3933, 3940.

VISCOSITY, FRICTION AND LUBRICATION.

3784. Viscosity Formula for Binary Mixtures. T. Ishikawa. *Chem. Soc. Japan, Bull.* 10. *pp.* 248–252, *June,* 1935. *In English.*—The nature of the solutional viscosity of solids in liquids is discussed [see Abstract 2881 (1935)], the association degrees of constituents being taken into consideration. In particular the data for KCl are utilised which for the molten salt satisfy the equation: $\log \eta_T = -3\cdot4530 + 1705/T$. The conclusion is drawn that solutional viscosity, derived from the Ishikawa formula (*loc. cit.*), is due to the block of a secondary structure in accordance with the secondary structure theory of crystals when the substance is an organic non-electrolyte, or is due to the ionic pair when the substance is an ionic salt. H. H. Ho.

See also Abstracts 3929, 3937.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3785. Corrective Systems for Astronomical Reflectors. M. Paul (Toulon).** *Rev. d'Optique,* 14. *pp.* 169–202, *May,* 1935.—The author classifies those optical systems which permit of improving the width of field and the illumination in reflecting telescopes, and discusses the systems of Ritchey and Chrétien, F. E. Ross and B. Schmidt. The present paper deals with the third-order aberrations, for which formulæ are compiled; the Schwarzschild-Chrétien method is used throughout. The various systems are fully analysed according as they consist of two or three thin elements. T. L. M.

***3786. Strengthened Cellular Mirrors for Astronomical Instruments. N. G. Ponomarev.** *Zeits. f. Instrumentenk.* 55. *pp.* 311–315, *July,* 1935.—The advantages to be gained by adopting the fused cellular method for large mirrors are discussed. New devices for the preparation of such discs are described. The cells are packed with and surrounded by asbestos and held in a special framework. The same oven is used for fusing and for cooling. Various experimental arrangements of the unsymmetrical cells round the edge are described. Two mirrors of about 1 ft. dia. have been prepared and one of 3 ft. is planned. T. L. M.

***3787. Contrast Stellar Photometer. R. Tremblot.** *Comptes Rendus,* 201. *pp.* 264–266, *July* 22, 1935.—The instrument is an adaptation of the Fabry-Buisson photometer for faint stars. Two adjustable achromatic prisms bring the images of the stars to be compared into coincidence at the primary focus. A low-power eyepiece serves as amplifying system. Two small uniform circular spots are seen against a background formed by a diffusing screen pierced by two apertures and suitably illuminated through a filter. The screen illumination is reduced just below that given by the fainter star; the observation is then made by reducing the light of the brighter star to give equal contrast. The accuracy appears not much inferior to 0·01 magnitude. Twinkling does not cause difficulty. It is advantageous to eliminate Purkinje effect by a filter. T. L. M.

See also Abstract 3864.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3788. Orbit of an Invisible Third Body in a Binary System. F. Zagar. *Accad. Lincei, Atti,* 21. *pp.* 508–515, *April* 7, 1935.—If A and B form a double system and C is a third small body very near B, it is shown that the motion of B relative to A is approximately composed of the two motions, (1) an undisturbed Keplerian motion of the centre of gravity G of B and C round A and (2) an analogous motion of B round G. If C is an invisible body, it is shown from this result how all the elements (except the major semi-axis) of the orbit of C round B can be deduced from observations on the apparent motion of B round A. A. J. McC.

3789. Problem of Two Fixed Centres of Force. G. Badalian. *Soc. Scien. Fennica, Acta and Comm. Phys.-Math.* 8. 2. [25 *pp.*], 1935.—The author re-examines the case of Newtonian attraction in detail, using a new method of geometrical representation which facilitates the classification of the numerous cases which arise. Considerable modifications of the results of previous investigators are necessary; these corrections are fully analysed and the author's notation is tabulated alongside that of Tallqvist. [See following Abstract.] T. L. M.

3790. Application of Elliptic Functions to Rectilinear Motion Under Two Centres of Force. H. Tallqvist. *Soc. Scien. Fennica, Acta and Comm. Phys.-Math.* 8. 11. [48 *pp.*], 1935.—The author re-examines the motion of a particle under two centres of force, along the line through both centres, and in certain cases along the symmetrical perpendicular, etc. The cases include both fields attractive, one or both repulsive, in all cases both Newtonian and varying as the cube of the distance, of equal and unequal strength; a Newtonian force combined with a homogeneous field, and with a force proportional to the distance (various cases of attraction and repulsion); etc. The mathematical treatment is detailed. [See Abstract 1000 (1934) and preceding Abstract.] T. L. M.

See also Abstract 3797.

NEBULÆ.

3791. Spectroscopic Parallaxes of 54 Galactic Clusters. Carol Anger Rieke. *Harvard Coll. Obs., Circ.* 397. [26 *pp.*], 1935.—The author derives the distances of 54 clusters spectroscopically on the basis of hydrogen line intensity, determining the parallaxes of 2700 early type stars. She describes the material and method, the zero point and scale of the spectroscopic parallaxes, the measuring and cosmical errors; gives a series of diagrams, including luminosity curves, and a catalogue with notes of the clusters. Since the absolute magnitudes are determined from line intensities, they are unaffected by space absorption. A method of measurement by visual comparison with a line-intensity scale, consisting of graded exposures on the Pleiades and a few supergiant stars is developed. It is shown that the dependence on spectral type and the divergences, from cluster to cluster, are within the limits of accidental error, and that the dispersion of the absolute magnitudes for line intensity is small. The line-intensity distances are therefore superior to those derived on the basis of spectral class. For the early type stars, within an area of diameter three times that given in star clusters, all are cluster members. Some members of *h* and χ Persei and of N.G.C. 6231 are as bright as absolute magnitude -6. Messier 7 is composed of high luminosity stars and N.G.C. 3532 of low luminosity stars; separate luminosity curves are given of these. A. S. D. M.

PLANETS.

3792. Empirical Formula Giving Distances of Formation of Successive Rings in Nebular Hypothesis. A. Auric. *Comptes Rendus*, 201. *pp.* 125–126, *July* 8, 1935.—The author gives a table of (1) the planetary distances from the sun in astronomical units; (2) the distances of the hypothetical rings from Mercury outwards, taking as base the asteroidal zone; and (3) the 6 hypothetical infra-Mercurial rings which are ignored since no planet was formed in them. He reduces his previous formula [see Abstracts 2413 (1929) and 558 (1930)] to $d/r = 2^n$,

where d is the diameter of the ring n, and r is the sun's radius (0·00465).
A. S. D. M.

See also **Abstract 3800.**

STARS.

3793. Theory of Astronomical Refraction and the Physics of the Atmosphere. V. Nobile. *Accad. Lincei, Atti,* **21.** *pp.* **615–620,** *May* **5,** and *pp.* **675–678,** *May* **19, 1935.**—A theoretical discussion is given of the obstacles to a satisfactory theory of astronomical refraction owing to insufficient knowledge of the physical constitution of the atmosphere. The following recommendations are made for collecting materials of observation: (1) To make use of observations of *meridian* zenith distances made in observatories furnished with modern equipment; (2) To select stars whose declinations are amongst the most certain that modern catalogues offer, with zenith distances distributed between 0° and 75° to N. and to S. and to carry out the observations in advanced hours of the night; (3) To choose for the measurements an epoch of the year in which it is possible to count upon a good number of evenings in excellent meteorological conditions and with these almost identical from one evening to another, so that it may be possible to refer the results to a well-defined state of the atmosphere and to realise as much as possible those conditions of mechanical equilibrium which the mathematical treatment of the problem shows to be required. J. J. S.

3794. Motion of B Stars. H. Mineur. *Bull. Astronomique,* **9. 1.** *pp.* **41–85, 1934.**—The discussion is based on the material collected by P. Giuntini and the author [see Abstract 2794 (1934)]. The components X and Y of the mean velocity of B stars at x, y in the galactic plane are developed to the third-degree terms in x, y. The constant and linear terms are naturally the most important but some of the others greatly exceed their mean errors. The curl of the vector X, Y appears constant in the field; its divergence is positive near the sun and decreases to zero at 200 parsecs. The Oort constants are recalculated. A comparison with the case of pure rotation (power series in the distance from the centre) gives very small coefficients after the first degree. The author then attempts to determine the variation of angular velocity with distance from the centre; he finds large departures from pure rotation. In a further section an attempt is made to resolve the velocities into pure rotation and a residual vector. The method is to assume that the residual has zero curl but divergence equal to that of the observed velocities. Again large departures from pure rotation emerge. T. L. M.

3795. Hydrogen Absorption for Stars in h and χ Persei. Y. Öhman. *Astron. Iakttagelser och Undersökning. Stockholms,* **12. 1.** [**17** *pp.*], **1935.**—A research into the physical nature of the luminosity effects shown by the hydrogen lines. These may be (1) real and (2) apparent luminosity effects, due (as in 1) to change in line intensity as a consequence of change in surface gravity in stars of the same temperature, and (as in 2) to the fact that most stars follow the main series in the Hertzsprung-Russell diagram. The (1) real luminosity effects may have two causes: (*a*) "abundance effects," that is different surface gravity values due to different hydrogen content, which again may differ for early and late spectral types or for giants and dwarfs; and (*b*) Stark broadening. When the Pleiades stars are considered they do not give a decisive answer except for the 4 brightest stars which indicate faintly the Stark effect as the cause of a real luminosity. For the two clusters in Perseus, the author finds that their cA-stars indicate that the continuous is almost independent of the luminosity in an A-type star, mainly recording temperature ; for such and for α Cygni the number of hydrogen atoms capable of absorbing Balmer lines is that of the ordinary A type, and is therefore due to Stark broadening. But for F and later types the Balmer lines are strong, and the real luminosity is due to " abundance." He considers the exceptional behaviour of white dwarfs, where there is absence of continuous absorption in hydrogen, and he attributes it to high atmospheric pressure giving the Stark effect. A. S. D. M.

3796. Effective Temperatures of Extended Photospheres. S. Chandrasekhar. *Cambridge Phil. Soc., Proc.* 31. *pp.* 390–393, *July,* 1935.—For material stratified in parallel planes in local thermodynamical equilibrium, a result of Milne leads to $T_e^4 = 0\cdot 8\ T_1^4$, where T_e is the effective temperature, T_1 the temperature at unit optical depth. The author extends the theory to include the curvature of the outer layers of extended photospheres and derives a similar result. T. L. M.

3797. Dynamics of Star Clusters. O. Heckmann and H. Strassl. *Göttingen Nachrichten,* 1. 13. *Fachgruppe* 2. *pp.* 153–170, 1935.—The authors discuss the solution of the distribution-equations given by their theory [see Abstract 2003 (1935)] particularly from the point of view of the determination of the arbitrary constants from experiment. Their principal conclusion is that there is no dynamical inconsistency in a falling-away of the velocity distribution of the stars of our neighbourhood from the distribution prescribed by the pure rotation theory. G. C. McV.

3798. Nebular Spectrum of Nova Herculis. D. Belorizky. *Comptes Rendus,* 201. *pp.* 191–193, *July* 16, 1935.—From the 16th Dec., 1934, to 5th April, 1935 (at least), the Nova's spectrum was stellar. It diminished in magnitude to 13 in May and then increased to 9 on 27th May when its spectrum was of isolated bright bands ; it brightened again to 7·8 by 18th June, remaining stationary, and with a nebular spectrum. Up to 27th January, the radial velocity increased [see Abstract 1515 (1935)] ; later it diminished from –850 km./sec. on 6th Feb. to –500 km./sec. on 27th May. During its stellar phase, the H emission lines were stationary as regards the Vega comparison lines, but by the 6th June there was appreciable displacement to the violet and on the 10th June, it was –350 km./sec. If these emission lines are chromospheric, this must be expanding at this rate, and may soon present an appreciable angular diameter. A. S. D. M.

3799. Continuous Spectrum of Nova Herculis. D. Barbier. D. Chalonge and E. Vasy. *Comptes Rendus,* 201. *pp.* 128–130, *July* 8, 1935.—The authors took some 40 spectra of Nova Herculis between 30 Dec. 1934, and 5 March, 1935, at Abisko, by a method previously described [see Abstract 1497 (1935)]. The spectra extend from 4900 Å to 3050. They consider the continuous spectra and give the registers by the microphotometer ; above 4500 Å the continuous spectrum is very feeble, and in this region is compared directly with γ Cas ; between 4000 and 4800 there is a hump similar to that found by Brill for Nova Gem (2) ; in both cases the hump decreases with the time. There is, however, no trace of Brill's maximum near 3600 Å, but that may be due to Brill's A-type comparison star for below 3700 Å. A. S. D. M.

3800. Determination of Systematic Errors of Star Positions. B. V. Numerov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 451–457, *June,* 1935. *In English.*—The author outlines a plan for determining the constant error of star catalogues (equinox corrections), especially that in declination, from cooperative observations of selected minor planets. Several oppositions must be observed for a complete revolution; a test on 6 oppositions of Leona gives satisfactory formulæ. The methods to be adopted in computing ephemerides to the necessary accuracy are discussed. The author prefers to concentrate attention on the equatorial zone, in preference to Brouwer's proposal to use planets of great inclination; reasons are given. A list of suitable planets down to 11·0 mag. is given, with a list of observatories whose cooperation is desirable. The designing of a suitable powerful meridian instrument is also under consideration at Leningrad, for erection at the Mountain Observatory of Abastuman. T. L. M.

See also Abstract 3787.

SUN.

3801. Systematic Inclination to the West of Prominences in Solar Equatorial and Medium Latitudes. Marguerite Roumens. *Comptes Rendus,* 201. *pp.* 127–128, *July* 8, 1935.—Between 1919–1920, the author studied some 4000 spectro-heliograms serving as synoptic charts of the chromosphere, published by the I.A.U., and analysed 171 of these. She found a dissymetry from that found in 1932 at Kodaikanal, in that the breadth of the absorption filaments was greater near the west than near the east limb. Out of the 171, 134 were inclined to the west, 36 to the east, and 1 was normal. The inclination showed a maximum frequency, near 7° W., a feebler one near 22° W., with a mean of 10° W. She attributes this to the existence of a high chromospheric wind towards the west, that is in the sense of the sun's rotation. A. S. D. M.

3802. Final Relative Sunspot-Numbers for 1934. W. Brunner. *Terr. Mag.* 40. *pp.* 215–217, *June,* 1935.

3803. Intensity of Sky Radiation. N. N. Kalitin. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 216–221, *May,* 1935. *In French.*—In order to study the ultra-violet radiations 3292, 3595 and 3944Å from the sky, observations were made with a Hilger spectrograph on a circle round the sky at the altitude of the sun around noon. The spectrograms so obtained were examined by a Moll microphotometer and the recordings are tabulated. The intensities of all three radiations considered, after showing a decrease with increasing distance from the sun, rise suddenly to a maximum at about 12° from the sun. Thereafter they decrease until about 110–120° when a gradual increase sets in again. It is thought that the variation in the neighbourhood of the sun may be due to the presence of haloes. The whole distribution is shown graphically: the author finds further that the albedo of the earth's surface exercises a considerable influence on the radiation from the sky, water and land behaving differently. To study the Mie effect properly, therefore, the surface must be homogeneous in all directions. A. E. M. G.

See also Abstract 3796.

GEOPHYSICS.

GEODESY.

3804. Determination of Anomalies of Vertical Gradient of Gravity. D. N. Chramov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 457–464, *June*, 1935. *In German.*—The problem is that of expressing gravitational anomalies in terms of anomalies of the vertical gradient. Numerov has derived formulæ, attaching much importance to the accurate determination of $\partial^2 V/\partial z^2$ for the reduction of gravity observations to the geoid [see Abstract 2021 (1935)]. The author derives a more accurate formula for this quantity and shows that it is equivalent to that of Numerov with an additional term whose value is in general less than 1×10^{-9}. T. L. M.

LAND, PHYSICS OF THE.

3805. Age of the Earth and Change of Earth Layers. S. v. Bubnoff. *Naturwiss.* 23. *pp.* 506–511, *July* 19, 1935.—The author refers to the use of radioactive changes in minerals in calculating the age of the earth and the values obtained in this way. The effects of denudation are next considered. Finally, the rates of sedimentation are discussed in detail for the various strata and ages are estimated for them. He considers that the length of the cycle is affected by the rotation of the axis for the greatest sea covering of the earth. R. S. R.

3806. Electrical Properties of the Soil. R. L. Smith-Rose. *Phys. Soc., Proc.* 47. *pp.* 923–931, *Sept.* 1, 1935.—Previous measurements [see Abstract 4103 (1934)] have now been extended to 100 Mc./sec. Substantially the same method has been used, but in order to provide an overlap with the previous work, the present measurements cover the frequency range of 1 to 100 Mc./sec. Check measurements carried out on small fixed resistors indicate that the overall accuracy at the highest frequencies is better than 20 %. It may now be stated that for normal samples of surface soil taken from the N.P.L., the conductivity is of the order of 10^8 e.s.u. at all frequencies up to 1 Mc./sec., rising to rather less than twice this value at 100 Mc./sec. Over the same frequency range, the dielectric constant decreases from about 10^5 at a frequency of 50 c./sec. to about 15 at 100 Mc./sec. An Appendix draws attention to the electrical-resistivity maps of England and Wales and of Southern Scotland, recently published by the British Electrical and Allied Industries Research Association. A comparison is made between the values therein and those obtained by the author. AUTHOR.

See also Abstract 3861.

METEOROLOGY.

3807. Light Absorption in the Atmosphere and its Photochemistry. O. R. Wulf. *J.O.S.A.* 25. *pp.* 231–236, *Aug.*, 1935.—From the distribution of, and absorption of light by, the gases of the atmosphere production of other absorbing gases, *e.g.*, O_3, by photochemical reactions must be due to the action of solar quanta of 2000 Å on H_2, N_2, O_2, and perhaps H_2O. This absorption and production, and resultant absorption by and decomposition of the products, are differently distributed in altitude. Absorption by O_2 leads to dissociation to O atoms, and that of N_2 (and H_2) to ionised N_2 (and H_2), thus explaining the light of the night sky, formation of O_3 deeper in the atmosphere, and its presence over a wide range of altitudes [see Abstract 1042 (1934)]. Low-altitude O_3 is also explained by the absorption dependent on the square of the pressure of O_2. Formation of H_2O_2 from dissociated H_2O is improbable, but that of an oxide of N through ultra-violet absorption is probable. C. A. S.

3808. Temperature of Upper Atmosphere Determined by Bands in the Auroral Spectrum. L. Vegard and E. Tønsberg. *Geofysiske Publ.* 11. 2. [14 *pp.*], 1935. *In English.*—The present memoir is a continuation of earlier work [see Abstract 152 (1933)]. Four spectrograms of the 4278 band are here discussed. The method of determining the temperature from band spectra is first set out. Thereafter from the photometer curves of the spectrograms, tables are compiled from which the temperatures are computed. The average temperature found from the four is 225·4° K. This temperature depends on the nature of the electric rays causing the aurora. Previous work has shown that these are mainly electron rays; also that these rays produce only a small change in the distribution of rotational energy, so that the band temperature is approximately that of the atmosphere. It is further pointed out that it is not possible to determine the temperature from the intensity distribution of the vibrational bands. The paper is illustrated by photographs and line diagrams. A. E. M. G.

3809. Lunar Atmospheric Pressure Inequalities at Glasgow. R. A. Robb and T. R. Tannahill. *Roy. Soc. Edinburgh, Proc.* 55. *Part I. pp.* 91–96, 1935.—The Glasgow barograph records have been retabulated according to lunar time, and the mean lunar diurnal inequalities for various groups of years and seasons analysed harmonically. The analysis shows that for the total period of 45 years the inequality can be represented by

$$0{\cdot}0640 \sin (\theta + 267°) + 0{\cdot}0156 \sin (2\theta + 285°) + 0{\cdot}0089 \sin (3\theta + 292°),$$

the amplitude being measured in millibars and θ being reckoned from upper lunar transit. AUTHORS.

3810. Vibrating Systems Exposed to Irregular Forces. K. Takahasi and K. Husimi. *Geophys. Mag., Tokyo,* 9. *pp.* 29–60, *June,* 1935. *In English.*—The differential equation $d^2z/dt^2 + 2\lambda dz/dt + \omega^2 z = f(t)$, in which t is the time and $f(t)$ is a very irregular function of t, can be applied to many everyday phenomena. It is called the statistical force and is studied for particular cases, but with the application of certain general assumptions. The authors show how the methods are applied to pick out the regular periodicity from irregularities. For atmospheric pressure, for the whole year, a period of 9 days predominates with minor periods due to damping. A fuller treatment is then made and the case of an external force consisting of discrete impulses is examined. H. M. B.

3811. Thermodynamics of Non-Uniform Systems in Meteorology. J. van Mieghem. *Geofysiske Publ.* 10. 14. [18 *pp.*], 1935. *In French.*—This paper is almost entirely mathematical. After a statement of the dynamical equations of viscous fluids and of the energy relation which can be deduced from them, the two fundamental principles of thermodynamics for a non-viscous fluid in motion are given. Thereafter different energy relations are established particularly those used in meteorology. A. E. M. G.

3812. Thermal Convection Currents. S. Sakuraba. *Geophys. Mag., Tokyo,* 9. *pp.* 1–9, *June,* 1935. *In English.*—Expressions are obtained for the problem of thermal convection currents and one form is suitable for use with a cyclone where the distribution of wind velocity does not obey the equation of continuity. Formulæ are derived for the distribution of heat with time and examples are given for an initial distribution of temperature. The equations and graphs show that the initial distribution may be destroyed rapidly by a drift flow when the temperature at the origin begins to decrease. It is considered that the results may be of assistance in investigating the thermal structure of a cyclone. R. S. R.

3813. Turbulent Motion in the Atmosphere. S. Sakuraba. *Geophys. Mag., Tokyo,* 9. *pp.* 11–21, *June,* 1935. *In English.*—Differential equations are developed using the law discussed by Solberg and Hidaka for the distribution of viscosity with height, $\eta = \eta_0 (1 \pm \sigma z)^2$, for a field of (i) vorticity conservation, and (ii) momentum conservation. Values of η_0 and σ are determined for each system for (1) spring and summer, at morning and mid-day, and (2) light, moderate and strong winds, using Dobson's results. The results are applied to the problem of drift currents in the steady state and Mediterranean observations support theory (i). Neither system explains satisfactorily the distribution of wind with height. The results of this and the earlier paper [see Abstract 650 (1935)] support Taylor's rather than Prandtl's theory of the mechanism of eddy diffusion. R. S. R.

3814. Nature of the Nucleus in Hygroscopic Droplets. J. H. Coste and H. L. Wright. *Phil. Mag.* 20. *pp.* 209–233, *Aug.,* 1935.—Reasons are given for the belief that, although sea-water is the chief constituent of nuclei in nature, most of the nuclei produced in civilised countries by the fires, furnaces, etc., associated with human activity are droplets of nitrous acid, some of sulphuric acid probably being formed also. AUTHORS.

3815. Light of the Night Sky. Analysis of Intensity Variations at Three Stations. (Lord) Rayleigh and H. S. Jones. *Roy. Soc., Proc.* 151*A. pp.* 22–55, *Aug.* 1, 1935.—This is a continuation and extension of earlier work [see Abstract 2155 (1930)] and the same instruments and methods are used. The yearly component appears to be dependent upon both magnetic and geographical latitude and would presumably be negligibly small near the equator. The amplitudes of (1) the annual variation are approximately equal in the auroral and red regions, but much smaller in the blue; and (2) the six-monthly variation is largest in the auroral and least in the blue region. Superposed on the periodic variations there is a slow variation in mean brightness together with irregular fluctuations. The irregular fluctuations at the three stations have no definite correlation, but for any one station there is a close correlation in the three spectral regions. The slow variation is most clearly defined in the auroral component and for all three stations there is a strong correlation between the mean yearly values and the mean yearly sunspot areas. There are indications of correlation between the variations in the blue and red regions and sunspot activity. In the mean the night-sky brightness tends to be greater on magnetically-disturbed than on quiet days. R. S. R.

***3816. Rate of Ascent of Pilot Balloons. P. Berger.** *Arch. de Sciences*, 17. *pp.* 213–225, *May–June*, 1935.—Figures are quoted showing the errors which arise in the rate of ascent for pilot balloons of different sizes with different ascensional speeds. The errors are a maximum for small balloons having a slow rate of ascent. They are in part due to differences in the physical properties of various samples of rubber. It is shown that for balloons of the same weight and colour, and with the same ascensional force, that the rate of ascent at constant air temperature increases as the excess internal pressure is decreased. It is suggested that manufacturers should quote for each sample of balloons the ascensional force as a function of the weight for different rates of ascent. R. S. R.

***3817. Sprung's Theory of the Weight-Barograph. H. Koschmieder.** *Geophys. Mag., Tokyo*, 9. *pp.* 23–28, *June*, 1935. *In German.*—The theory and method of deducing results from the readings of this barograph as given by Sprung [see Abstract 1352 (1905)] are completely confirmed by a simpler method based on the idea of pressure force. C. A. S.

See also Abstracts 3793, 3803, 3819, 3827, 3853.

SEISMOLOGY.

3818. Strain Produced by Surface Forces in a Semi-Infinite Elastic Solid. H. Honda and T. Miura. *Geophys. Mag., Tokyo*, 9. *pp.* 61–81, *June*, 1935. *In English.*—The general solutions for the elastic equilibrium of a semi-infinite elastic solid due to normal and tangential forces applied to its surface are obtained. The displacement due to the static force which has only one radial, transverse or vertical component is discussed. It is suggested that some of the results may be applied to the elucidate the nature of the deformation of the earth's crust accompanying severe earthquakes. AUTHORS.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3819. Auroral Height Measurements with Long Base-Lines. C. Størmer. *Geofysiske Publ.* 11. 3. [15 *pp.*], 1935. *In English.*—The positions of the stations are indicated on a chart, the longest base-line, 385 km., being between Kongsberg and Løkken Verk. Simultaneous photographs are obtained at two or more of these stations. The method of interpreting these photographs, using one station as a main station, is briefly set out. Special cases are investigated and the results tabulated. The heights of several points on the same aurora are determined. The results obtained agree whatever station be used as a main station. From the investigation the author concludes that the use of very long base-lines can give exact measurements even for diffuse arcs and patches, while for pulsating forms the so-called " space effect " has no practical influence on height measurements. For well-defined auroral forms the error can be less than 1 %. A large number of diagrams and photographs are appended. A. E. M. G.

See also Abstracts 3806, 3808.

RADIOACTIVITY.

3820. Asymptotic Solution of an Equation Occurring in the Theory of Radioactive Emission. M. Frenkel. *Zeits. f. Physik*, 95. 9–10. *pp.* 599–629, *July* 1, 1935.—The equation $\ddot{y} + y\,(1 - \frac{a}{x}) = 0$ where 'a' is complex is used in hydrodynamics for stability problems of Poiseuille flow; in thermionics, for calculating transmission coefficients; and in radioactivity for calculating decay coefficients and anomalous scattering. The author studies this equation and obtains asymptotic solutions. J. E. R. C.

3821. Ionisation Currents Produced by Radon, RaA and RaC′ in Cylindrical Ionisation Chambers. Robley D. Evans. *Phys. Rev.* 48. *pp.* 177–186, *Aug.* 1, 1935.—A general theoretical equation is derived and experimentally confirmed for the ionisation produced in cylindrical ionisation chambers by Rn and its decay products. General equations are also derived for α-ray ionisation (1) above a plane surface due to a homogeneous radioactive substance below the plane, and (2) a radioactive substance uniformly distributed on a wire normal to the plane, and (3) for the ionisation outside a dihedral right angle enclosing a homogeneous radioactive substance. AUTHOR.

3822. Relation between Wave-Length and Absorption of γ-Rays in Heavy Elements. W. Gentner. *J. de Physique et le Radium*, 6. *pp.* 274–280, *June*, 1935.—Recent results are examined and on both theoretical and experimental grounds it is concluded that μ (total coefficient of atomic absorption) $= \sigma + \tau + \kappa$, σ, τ and κ being the coefficients of partial atomic absorption due respectively to Compton effect, photoelectric effect, and materialisation of photons. Using respectively the Klein–Nishina formula, and the methods of Hulme, etc., and of Bethe and Heitler [see Abstracts 1550 (1935) and 3411 (1934)] σ, τ and κ have been calculated for Pb for 29 values of λ ($4 \cdot 65 - 48 \cdot 9$ X), and compared with experimental results. One new value has been determined by the author's method [see Abstract 1965 (1934)]; for λ 46 $\mu = 18 \cdot 1$, while by calculation as above σ, τ and κ ($\mathrm{x}10^{23}$) $= 2 \cdot 9$, $14 \cdot 5$ and 0 respectively giving $\mu = 17 \cdot 4$. Considering all causes of error it is considered that the three above causes account for 99 % of the whole absorption, though the average difference between the theoretical and experimental values of μ for $\lambda < 25$ X is $4 \cdot 4$ %, for $\lambda > 25$, 24 %, or ignoring sign $4 \cdot 6$ and 26 %. C. A. S.

3823. Formation of Electron-Positron Pairs by Internal Conversion of γ-Radiation. M. E. Rose and G. E. Uhlenbeck. *Phys. Rev.* 48. *pp.* 211–223, *Aug.* 1, 1935.—The production of an electron and positron by the spherical γ-wave emitted from a nucleus has been considered on the basis of different approximation methods. Regarding the nucleus as a Hertzian oscillator, both the dipole and quadripole radiation are treated. The approximate methods, which may be classified according to which of a certain set of parameters (the momenta of the particles, αZ, and eventually the ratios of these) are to be considered small, form a consistent scheme. A discussion of the qualitative features of the angular and energy distribution is given and a comparison is made with the rigorous treatment of the problem by Jäger and Hulme. This shows that both the differential and total internal conversion coefficient may be computed with a fair degree of accuracy by the combined use of the Born and the Schrödinger approximation results. AUTHORS.

3824. Inelastic Scattering of Quanta with Production of Pairs. M. S. Plesset and J. A. Wheeler. *Phys. Rev.* 48. *pp.* 302–306, *Aug.* 15, 1935.—The problem of accounting for the anomalous scattering of γ-rays suggests the importance of investigating the probability of processes in which an incoming quantum produces an electron-positron pair in the field of a nucleus, going on in a new direction with diminished energy. To determine the cross-section in the general case is difficult, but an estimate of the total magnitude of the effect in the energy range of interest is obtained by a calculation of the cross-section as a function of the energies of the incident and scattered quanta and the angle between them in the limit where the electron-positron pair is produced with small kinetic energy. While there exists a possibility of observing the process under suitable experimental conditions, the cross-section is found to be too small to contribute appreciably to the production of the hard component in the radiation from heavy elements exposed to penetrating γ-rays. AUTHORS.

***3825. Examination of Nuclear Processes by Coincidence Methods. W. Bothe and H. J. v. Baeyer.** *Göttingen Nachr.* 1. 16. *Fachgruppe* 2. *pp.* 195–197, 1935.—Using a central tube counter surrounded by 8 others, the simultaneous emission of different types of radiation during nuclear transformations may be examined. The corpuscles are registered by the central counter while the γ-rays are measured by coincidences between the central and one of the surrounding counters. For example, using a source of RaE inside the central counter, for every 1000 β-particles registered, $1\cdot 39 \pm 0\cdot 27$ coincidences were obtained, corresponding to the emission of one γ-ray for every β-ray. In further experiments with a Po-B source, coincidences were established between the emitted γ-rays and the second longest (33-cm.) group of protons, whereas when the latter were completely absorbed with cylindrical absorbing sheets so as to leave only the protons of 75-cm. range, no coincidences were found. F. C. C.

***3826. Corrections for γ-Ray Absorption in the Measurement of Low-Activity Materials. H. Franz and C. Weiss.** *Phys. Zeits.* 36. *pp.* 486–489, *July* 15, 1935. *From the Reichsanstalt.*—Describes apparatus for the measurement by a γ-ray method of the Ra content of low-activity materials. Tubes of various diameters up to 24 mm. were filled with radioactive residue ($1\cdot 17 \times 10^{-3}$ mg. Ra/gm.) their apparent radium contents determined. A linear relationship was found to exist between the apparent Ra content/gm. and the diameter of the tube and extrapolation to zero diameter gave the true Ra content/gm. The dependence of absorption correction on density was investigated by measuring the apparent Ra content of tubes 24 mm. diameter filled with mixtures of various substances and known quantities of radium. A smooth correction-density curve was obtained. This curve and the linear relationship referred to above can be used to estimate absorption corrections from the density of the material and the tube diameter. W. E. P.

See also Abstracts 3711, 3716, 3775, 3861, 3971.

RADIATION.

ABSORPTION AND TRANSMISSION.

3827. Atmospheric Absorption Coefficients. J. Duclaux. *J. de Physique et le Radium*, 6. *pp.* 323–328, *July*, 1935.—The usual methods for absorption measurements are not suitable in the case of the atmosphere on account of its great transparency. The method adopted consisted in measuring photographically the brightness of a distant object (26 km.) and that of the adjacent sky; from the variation of these values the absorption coefficient is deduced. Photographs for a series of measurements comprising seven colours in the range 3700–6670 Å were taken in light rendered approximatively monochromatic by means of colour filters. [See Abstract 1554 (1935).] N. M. B.

See also Abstracts 3847, 3849, 3862.

COLORIMETRY.

3828. Maximum Visual Efficiency of Coloured Materials. D. L. MacAdam. *J.O.S.A.* 25. *pp.* 249–252, *Aug.*, 1935.—The term "visual efficiency" is used here to represent interchangeably the concepts of visual transmission factors of filters and of visual reflection factors of reflecting surfaces. Fluorescent substances are excluded from consideration. The partial absorption of incident energy, necessary for the appearance of hue, obviously decreases the visual efficiency below the unit efficiency characteristic of a non-absorbing, hueless, white material. Of all the spectrophotometric curves of materials exhibiting a given chromaticity when illuminated with light of a specified quality, there must be at least one which yields a maximum value for the visual efficiency. This paper describes the general type of spectrophotometric curve which is known to have this unique property. A new proof of the validity and uniqueness of this type of curve is presented. AUTHOR.

3829. Disc Colorimetry. Dorothy Nickerson. *J.O.S.A.* 25. *pp.* 253–257, *Aug.*, 1935.—This report provides a certain amount of information necessary for careful work with the disc method of colorimetry. Colour temperatures are given for lamp and filter combinations of available instruments. Tristimulus specifications are given: for several Munsell papers under I. C. I. standard illuminants; for certain glossy papers under diffuse and 45° directional illumination; for colours made in the Munsell laboratory to match other colours when it was necessary to use different pigments; for several methods of computation, by summation for 5 and 10 mμ intervals, and by 10 and 30 selected ordinates; for curves differing slightly from each other; and for colour differences significant in cotton grading. These last-mentioned figures are given as a basis for the comparison of the significance of all of the other differences.

AUTHOR.

***3830. Trichromatic Colorimeter. J. Wouda.** *K. Akad. Amsterdam, Proc.* 38. 6. *pp.* 585–589, 1935.—Describes an attachment to a spectrometer by means of which it is possible to determine rapidly the three colour components of any given light. At convenient intervals (100 Å) a spectrophotometric measurement is made, using a neutral wedge moved by a drum so designed that the scale of densities is logarithmic. By means of a cylinder on which the stimulation curves are plotted logarithmically, the product of the energy and the stimulation is obtained immediately and the results are added for each of the three colour sensations. J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3831. Electro-Optical Kerr Effect in Ammonia, Nitrogen and Oxygen. W. M. Breazeale. *Phys. Rev.* 48. *pp.* 237–240, *Aug.* 1, 1935.—Absolute values for the Kerr constant in anhydrous NH_3, N_2 and O_2 have been determined. Measurements in NH_3 were made at wavelengths of 6500 Å and 5750 Å, pressures from 13 to 30 atmospheres, and temperatures from 40° to 80° C. In N_2 and O_2 the wave-length used was 6500 Å, pressures in the neighbourhood of 100 atmospheres and temperatures from 20° to 65° C. The absolute value for the Kerr constant reduced to N. P. T. and 6500 Å is for NH_3 $(62{\cdot}3 \pm 1{\cdot}8)10^{-12}$, for N_2 $(4{\cdot}64 \pm 0{\cdot}10)10^{-12}$ and O_2 $(6{\cdot}94 \pm 0{\cdot}30)10^{-12}$. AUTHOR.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

***3832. Decay of Fluorescence. W. Szymanowski.** *Zeits. f. Physik*, 95. 7–8. *pp.* 440–449, *June* 26, 1935.—The Kerr cell method of Gaviola has been improved. Greater light intensity is obtained by the use of a higher frequency for the high tension, while greater accuracy is obtained by the use of a Babinet soleil compensator with a Szivessi plate. By taking two phase shift curves—functions of distance of Kerr cell from the scattering object (mirror or fluorescent substance) and taking the relative displacement of their minima the difficulties discovered by Duschinsky are obviated. The average accuracy of the improved arrangement is from $0{\cdot}2$ to $0{\cdot}3 \times 10^{-9}$ sec. It is shown that the general fluorometer theory of Duschinsky is correct. The exponential law of decay is satisfied for dilute solutions of fluorescein in water. The objections of Weisskopf to this method of getting decay times are considered invalid here, since a broad band of the spectrum on the white light is used. J. E.

3833. Influence of Concentration of Dyestuff and Viscosity of Solvent on Fluorescent Decay. W. Szymanowski. *Zeits. f. Physik*, 95. 7–8. *pp.* 460–465, *June* 26, 1935.—The results show that the usual explanation of quenching by collisions of the second kind can only hold in special cases. Nor are the results brought into line with this theory by the introduction of a sphere of action. [See preceding Abstract.] J. E.

3834. Molecular-Rotation Effect on Fluorescent Decay. W. Szymanowski. *Zeits. f. Physik*, 95. 7–8. *pp.* 466–474, *June* 26, 1935.—The predictions of the Jablonski theory of the decay of fluorescence of solution are confirmed. If the fluorescence light is polarised the decay time depends on the direction of vibration : that of the component parallel to the direction of the exciting light vibration is shorter than that of the component at right angles. The decay time is related to the degree of polarisation. The measurements were carried out on mobile, viscous and solid solutions of dyestuffs by use of the new fluorometer [see preceding Abstracts]. The results obtained with fluorescein in glycerin-water solution indicate that not only the decay time but also the actual life of the excited molecule depends on the solvent. J. E.

3835. Quenching of Iodine Fluorescence by Benzene Vapour. J. P. Howe and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 57. *pp.* 1262–1265, *July*, 1935.—The quenching of iodine fluorescence by benzene at pressures of the latter below 1 mm. has been studied. The quenching is not of the simple type encountered in some systems and a complete explanation necessarily involves the assumption of several excited states which may be formed from the primarily excited state by collision. The use of two such states leads to a satisfactory equation, but a larger number probably take part in the phenomenon. AUTHORS.

3836. Effect of Foreign Inclusions on the Electrically Stimulated Phosphorescence of Thin Layers of Al_2O_3. H. Betz. *Zeits. f. Physik*, 95. 3–4. *pp.* 189–197, *June* 4, 1935.—By electrolytic formation of oxide layers on thin sheets of aluminium alloyed with small proportions of other metals (Cr, Cu, Fe, Mg, Mn, Ni, Si, Ti and Zn) the effect of such foreign substances on the electrically stimulated phosphorescence of the oxide layer was studied. Curves relating the phosphorescence brightness with forming voltage were determined for each aluminium alloy and for pure aluminium, and show that at a given forming voltage the brightness is the same for pure aluminium and for alloys containing Cr, Cu, Fe or Mg. The addition of Zn was found to decrease the phosphorescence brightness, while Mn had the opposite effect. In the latter case the variation of the increased brightness with the proportion of Mn showed that the effect increased with Mn content up to between 1 and 2 % when it reached a saturation value. The proportional increase in phosphorescence brightness over that obtained with pure Al also depended on the formation voltage. W. S. S.

3837. Influence of an Electric Current on the Phosphorescence of Zinc Sulphides. G. Déchêne. *Comptes Rendus*, 201. *pp.* 139–142, *July* 8, 1935.—The outstanding phenomena associated with the influence of an electric current on the phosphorescence of ZnS phosphors are correlated and discussed. W. R. A.

3838. Decline of Phosphorescence. M. Curie. *Comptes Rendus*, 201. *pp.* 142–143, *July* 8, 1935.—The hyperbolic law of the decline of phosphorescence for sulphide phosphors [see Abstract 4502 (1934)] does not hold for the beginning or end of the emission. A theoretical extension is put forward. The scattering electrons of luminogenous centres, following ionisation excitation, find themselves in non-identical conditions in the interionic field. W. R. A.

INTERFERENCE. DIFFRACTION AND SCATTERING.

3839. Coherence of Luminous Radiations. M. Cau and F. Esclangon. *Comptes Rendus*, 201. *pp.* 270–273, *July* 22, 1935.—Classical theory of interference supposes a limited length to a train of waves. Gouy, Rayleigh and Schuster, however, attribute the luminous regularity to the spectroscope itself, any such instrument being useful as a monochromator up to the limit of its resolving power. Experiments with a Rowland grating, Michelson échelon and Fabry-Perot étalon show that both hypotheses lead to the same results. F. S.

3840. Diffraction of a Progressive Wave by a Semi-Infinite Screen. L. Cagniard. *J. de Physique et le Radium*, 6. *pp.* 310–318, *July*, 1935.—A theoretical study is made of the wave produced when a

progressive wave, initially spherical, but of arbitrary profile, is obstructed by a semi-infinite screen. A new method of calculation is used with the object of obtaining results which can be readily applied to physical problems without having to use approximations. The fundamental formulæ are developed but applications of them are deferred to a later paper.
J. E. R. C.

3841. Iridescent Shells. Part III. Body-Colours and Diffusion-Haloes. C. V. Raman. *Indian Acad. Sci., Proc.* 1*A. pp.* 859–870, *June,* 1935.—The crystalline particles [see Abstract 3746 (1935)] present in nacre diffract or diffuse light in a manner determined by their size, shape and arrangement and give rise to various optical effects. The forward diffusion of light through nacre and the colours arising therefrom, exhibited by iridescent shells observed as "translucencies," are described. Backward diffusion of light or body-colours complementary to the iridescent reflections tend to dilute the latter. The diffusion-haloes observed when a source of light is viewed through a thin polished plate of nacre are discussed. The colours of the transmitted light are a function of the thickness of the nacre and indicate the existence of three distinct factors which determine the extinction coefficient. Lateral or transverse diffusion of light occurs through great thickness in several kinds of nacre and indicates that nacre is a highly anisotropic medium. [For Parts I and II see Abstract 2511 (1935).] AUTHOR.

3842. Optical Phenomena Connected with Change in Size of Spherical Particles. T. Judalevič. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. 5–6. *pp.* 368–373, *May,* 1935. *In English.*—Theory of light scattering developed from Rayleigh and Mie equations and specially applied to water droplets. A. S. C. L.

See also Abstracts 3746, 3752, 3851, 3863.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3843. Photochemical Decomposition of Methyl and Ethyl Alcohols. F. Patat. *Zeits. f. Elektrochem.* 41. *pp.* 494–498, *Aug.,* 1935.—Under the influence of light between 2000 and 1800 Å these alcohols decompose into H_2 and aldehyde, but no H atoms appear. The quantum yield is of the order of magnitude 1. Whether the electron jump occurs in the CH_3- or in the OH-linking remains undecided. Electron stimulus in the C-OH linking is excluded. T. H. P.

3844. Lighting for Photographs and Engravings. G. Colange. *Comptes Rendus,* 201. *pp.* 204–206, *July* 16, 1935.—In measuring densities of photographic papers the angle of incidence of the illuminating beam is important. In photographs, engravings and coloured pictures excessive contrast is softened by normal, insufficient contrast heightened by oblique, illumination. C. A. S.

3845. New Method for the Testing of Photographic Shutters. J. A. M. v. Liempt and J. A. de Vriend. *Zeits. f. Physik,* 95. 3–4. *pp.* 198–201, *June* 4, 1935.—The shutter was placed between a tungsten filament opal lamp and a cæsium vacuum photoelectric cell giving a response current proportional to the incident light and hence to the shutter opening. The voltage generated by the passage of the photoelectric current through a high resistance was applied to the deflecting plates of a kathode-ray oscillograph. The light spot on the fluorescent screen of the oscillograph and a small a.c. neon light (to fix a time scale) were photographed together on a moving plate actuated by a spring which was released simultaneously with the release of the shutter. In this way the complete time-opening curve of the shutter could be obtained and from this the equivalent exposure and the efficiency could be calculated. W. S. S.

***3846. Precision Ultra-Violet Actinometer. L. Harris and J. Kaminsky.** *Am. Chem. Soc., J.* 57. *pp.* 1154–1159, *July*, 1935.—The Einstein equivalence law has been found to hold for the photolysis of malachite green leucocyanide with an accuracy of 2·5 % in absolute value and an average precision of 1·4 % for three wave-lengths. This accuracy is considerably greater than previously attained in such measurements. An actinometer using this solution is especially adapted for the measurement of very small light energies. A standard actinometer employing this substance has been proposed and the effects of different conditions upon the behaviour have been examined. A null method of comparison has been proposed and found satisfactory to 3 % in absolute value. Other variations of the standard actinometer (as the temperature coefficients) were investigated with the aid of this null method. Other actinometers which used monochloroacetic acid and crystal violet leucocyanide were tested and found to be less desirable. AUTHORS.

See also Abstracts 3734, 3807, 3913.

PHOTOMETRY.

3847. Interface Reflections between Plane Parallel Surfaces. F. Benford. *Gen. El. Rev.* 38. *pp.* 277–281, *June*, 1935.—When plane parallel photometric filters are combined in a parallel position the transmitted light contains rays which have been reflected once at a surface of one filter and once at a surface of another. Owing to this interaction the transmission of the combination is not determined solely by the transmissions of the individual filters, and the order in which the filters are arranged may be of importance. The theory of interface reflections is briefly outlined with special reference to groups of filters used for changing the colour-temperature of the light from a standard lamp. An empirical equation is derived giving the change of colour-temperature produced by combinations of 2, 3, 4 and 5 filters in terms of the ratings of the individual filters and constants connected with the interface reflections which can be determined by counting. In general the change of colour-temperature produced by a given group of filters depends on their order and in this way many more colour-temperatures are obtainable than would otherwise be the case. W. S. S.

***3848. Effect of Moisture on Photometric Integrators. H. Buckley and W. Barnett.** *Journ. Sci. Instruments*, 12. *pp.* 258–259, *Aug.*, 1935.—The authors find that absorption of water vapour from the air may change the constant of a photometric integrator by as much as 8 % when a magnesium carbonate surface coating is used. The constant gradually changes during the course of work as the heat from the lamps being measured causes the paint to lose the absorbed moisture, with the result that the reflection factor of the paint gradually rises. J. W. T. W.

***3849. Recording Goniophotometer. J. M. Slater.** *J.O.S.A.* 25. *pp.* 218–223, *July*, 1935.—Describes an apparatus designed to simplify the obtaining of angular illumination distribution records, in which photographic records of the distribution of light reflected from a surface, over a considerable angle, are obtained in one operation. The instrument consists of a small over-run electric lamp, the light from which, after passing through two baffles, is collimated by a lens. The beam is then restricted by a horizontal slit so that a ribbon of light is directed on to a suitably inclined sample. An optical wedge which is approximately a quadrant of a hollow cylinder is mounted over the sample with its axis coincident with the illuminated line of light on the sample, and a piece of photographic film or paper is placed in contact with the outside surface of the wedge. The wedge grades in opacity from one side to the other, along the direction of its axis. A modification of the apparatus, making it suitable for transmission measurements, consists of mounting the sample vertically near to the slit, the wedge and photographic paper being mounted behind the sample with the axis again coincident with the illuminated line. The method of producing the wedge is briefly discussed and then numerous examples of records obtained with the apparatus are given and described. In measuring reflections from many selectively reflecting materials, the variation of the colour of the light with angle must be taken into account. This is done by using a panchromatic film with the appropriate orthochromatic filter instead of the bromide paper. R. C. F.

***3850. Photon Counters for Visible Light. A. Kolin.** *Rev. Sci. Instruments*, 6. *pp.* 230–231, *Aug.*, 1935.—Describes various methods by which it is possible to prepare the metal kathodes in photon counters by evaporation of the alkali or alkaline earth metals. The author states the performance of a sodium counter and of a calcium counter which he prepared by the methods described. J. W. T. W.

See also Abstract 4012.

POLARISATION.

3851. Molecular Clustering in Binary Liquid Mixtures. R. S. Krishnan. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 915–927, *June*, 1935.—Measurements of the depolarisation ρ_u, ρ_v and ρ_h [see Abstract 2990 (1935)] were made, using, respectively, incident unpolarised light and incident light polarised with vibrations vertical and horizontal, for mixtures of eight different pairs of liquids over a range of temperature of about 30° above the critical solution temperature. The results obtained fully confirm the author's preliminary report [see Abstract 245 (1935)] regarding the existence of clusters in liquid mixtures, not only at the critical solution temperature but also at temperatures considerably removed from it. The validity for such mixtures of the optical reciprocity principle has been verified experimentally. It is also shown that the observed values of ρ_u, ρ_v and ρ_h satisfy the relation $\rho_u = (1 + 1/\rho_h)/(1 + 1/\rho_v)$. The X-ray evidence regarding the state of dispersion of the molecules in liquid mixtures of the type phenol and water is in agreement with the optical evidence presented in this paper. The bearing of the results on theories of critical opalescence is discussed. AUTHOR.

RADIATION, EMISSION.

3852. Short-Wave Propagation through the Auroral Region. N. Stoyko and R. Jouaust. *Comptes Rendus*, 201. *pp.* 133–134, *July* 8, 1935.—Observations have been made on the time of propagation of the time signals emitted from Honolulu on a wave of about 37 m. and

received in Paris. This determination is only possible due to the fact that the Arlington and Annapolis time signals in addition to the Honolulu ones are simultaneously recorded both at Paris and Washington. Assuming a velocity of propagation of 270,000 km./sec. as between France and America then the velocity for the Honolulu signals which have passed over the polar regions comes out at 270,200 km./sec. when the path is in total darkness. For those signals received with the path in daylight the value obtained is 291,000 km./sec. This value is in accordance with previous observations of a similar nature. [See also Abstract **3444** (1935).]
F. S. B.

3853. Temperature Changes in the Higher Atmosphere. E. V. Appleton. *Nature*, 136. *pp.* 52–53, *July* 13, 1935.—Measurements by the critical penetration method show that the maximum ionisation in the F-layer is actually less on a summer noon than on a winter noon. This result is in such striking disagreement with the simple theory of photo-ionisation by solar radiation which so adequately explains the phenomena associated with the E-layer that some other explanation for this discrepancy must be found. Theory indicates that the summer noon ionisation should be twice the winter noon ionisation, but this is on the assumption that the atmospheric distribution of molecular density with height is constant throughout the year. The low value of summer noon ionisation can be explained on a basis of reduced air density arising as the result of an increased temperature. On this basis it is found that the atmospheric temperature at height of the order of 300 km. must be at least 1200° K. on a summer day. The cooling which must necessarily set in on a winter night with a consequent shrinkage of the outer layer of the atmosphere also explains the sudden check in the decay of the F-region ionisation which is observed under these conditions. F. S. B.

3854. Theory of the Ionosphere. E. O. Hulbert. *Terr. Mag.* 40. *pp.* 193–200, *June*, 1935.—This is a survey of present knowledge of the ionosphere based largely on measurements of the Bureau of Standards and of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. The general conclusion is drawn that the ionisation is caused mainly by the ultra-violet light of the sun. In the conclusion it is remarked that the complex variations of the ionisation of the F-layer require the effect of heating and dissociation by sunlight to be taken into account. F. S. B.

3855. Periodic and Irregular Phenomena in the Ionosphere. K. W. Wagner and K. Franz. *E.N.T.* 12. *pp.* 211–213, *July*, 1935.—Experiments with waves of frequency 2 Mc./s. show the effects in the F-layer of the ionosphere to be far more regular at sunrise than at sunset. At sunrise the results all lie very close to the line which corresponds to the sun 7·5° below the horizon. Sunset effects are far more irregular and the incidences of sunrise and sunset effects are unsymmetrical with respect to true mid-day. The curve showing the time of incidence of direction-finding errors for the mid-European broadcasting stations, on magnetically steady days at Tromsö, is seen to be symmetrical, the time being at about 15 h. (mid-European time) towards the end of December, about 24 h. near the end of June, with a gradual change between these months. A diagram is also given correlating the following effects: (*a*) earth's magnetic variations; (*b*) reflection of 150-m. waves; (*c*) reflection of 75-m. waves; and (*d*) incidence of direction-finding errors; the period covered from January to December, 1934. The results are briefly discussed and explanations offered in certain cases. A. W.

3856. Structure of the Ionosphere. J. Hollingworth. *Phys. Soc., Proc.* 47. *pp.* 843–851, *Sept.* 1, 1935.—The paper suggests a method of giving an approximate value to the intensity of ionisation in the space between the E- and F-layers by measuring the relative group retardation of the two components of an echo from a pulse whose frequency is so close to the critical frequency of the E-region that one component is reflected from the E-layer and one from the F. It is pointed out that the value of the inter-layer ionisation is of the utmost importance in determining the path of long-distance transmissions. From the results it is concluded that probably this inter-layer ionisation is fairly uniformly distributed over the space between the layers, and is only a few per cent. less in value than that at the top of the E-layer. AUTHOR.

3857. Equatorial Longitude Effects on Cosmic Rays. R. A. Millikan and H. V. Neher. *Nat. Acad. Sci., Proc.* 21. *pp.* 313–315, *June,* 1935.—Reference is made to the results obtained by the authors and by Clay on the changes in the cosmic-ray intensity at sea level when going from the temperate zone into the equatorial belt. These indicate the dissymmetry of the earth's magnetic field at great heights. The dip in intensity sets in at 41° or 42° magnetic latitude in all areas tested and is greatest near Singapore and Batavia and least in the Atlantic. Results are also being obtained from high altitude flights in Peru, the Philippines, Java and Singapore and those from Peru are quoted. These should provide an indication of the existence of incoming photons. R. S. R.

3858. Nature of Cosmic Radiation. T. H. Johnson. *Frank. Inst., J.* 220. *pp.* 41–68, *July,* 1935.—Review of the work which has led to the present state of knowledge concerning cosmic rays. F. C. C.

3859. Attempt to Analyse Cosmic Rays. A. H. Compton. *Phys. Soc., Proc.* 47. *pp.* 747–773, *July* 1, 1935.—A full discussion is given of experimental evidence which leads to the conclusion that almost all of the primary radiation entering the atmosphere is electrically charged. A method of analysing these electrically-charged rays is described. It is based on a consideration of the effect of the earth's magnetic field and atmosphere on various types of particle. Altitude-ionisation measurements at various latitudes then indicate three groups of particles, which are identified with α-particles, electrons (both positive and negative in approximately equal amounts) and protons, in order of increasing power of penetrating the atmosphere. This identification is questionable on account of the possible errors, but comparison with other data is on the whole confirmatory. The failure to find proton tracks in cloud-chamber photographs is a difficulty, but a possible explanation is offered. D. H. F.

3860. Positive and Negative Primary Cosmic Radiation. J. Clay. *Physica,* 2. *pp.* 861–869, *Aug.,* 1935. *In English.*—From the combination of latitude effect and east–west asymmetry it is possible to conclude whether there are positive and negative primaries. A ratio of the number of positives to negatives of about 2 to 1, between two given energy limits, was obtained. A north excess of 4 % was found in Bandoeng for 20° zenith distance. The decrease of the penetrative part of the corpuscles in lead at Bandoeng (18° M.L.) was much smaller than in Amsterdam (53° M.L.). In Amsterdam the same decrease was found by Rossi. AUTHOR.

3861. Radioactivity of Earth's Crust and Cosmic-Ray Observations. Robley D. Evans and R. W. Raitt. *Phys. Rev.* 48. *pp.* 171–176, *Aug.* 1, 1935.—Ra analyses of 23 rock-specimens discloses a linear relationship between the average Ra content of the terrain and the local γ-ray ionisation in the cosmic-ray electroscope. Ionisation due to soft γ-radiation stimulated in the earth's crust by the impact of cosmic rays, or due to the reflection of cosmic rays by the earth's crust is therefore negligible, and the ratio of Th to U is approximately constant in the materials examined. A local γ-ray ionisation of 5·5 ion pairs per sec. per cm.^{3}, in air at one atmosphere pressure, is normally associated with a content of $1 \cdot 0 \times 10^{-12}$ gm. Ra per gm. rock in the neighbouring terrain. It is shown that the γ-ray ionisation n ion pairs per cm.^{3} per sec., at h cm. above a broad radioactive surface is $n = (2\pi\rho mK/\mu_1)G\mu_h$, where $G\mu_h \equiv \int_1^\infty z^{-2}e^{-\mu hz}dz$, μ_1/ρ is the mass absorption coefficient and m the Ra concentration of the emitter, μ is the γ-ray absorption coefficient of air, and K is Eve's number. Application to the experimental data suggests that the Th/U ratio is the order of 5 to 10 for many common geological materials. AUTHORS.

See also Abstract 3806.

REFLECTION. REFRACTION AND DISPERSION.

3862. Infra-Red Reflecting Powers of Aqueous Solutions. F. Matossi and H. Fesser. *Zeits. f. Physik*, 96. 1–2. *pp.* 12–28, *July* 25, 1935.—The reflecting powers of aqueous solutions of LiCl, NaCl, KCl, NaBr, NaI, $CaCl_2$ and $LiNO_3$ in the regions of H_2O bands $\lambda\lambda$ 3·05 and 6·31μ are measured and compared with those of pure water. Apparatus and method are described; results are shown in tables and diagrams and discussed. Reflecting powers at both $\lambda\lambda$ increase in going (i) from pure water to each solution, (ii) from NaCl through NaBr to NaI, *i.e.*, with increasing anion radius, (iii) from KCl through NaCl to LiCl, *i.e.*, with diminishing kation radius. These changes are explained on the assumption of depolymerising and hydrating actions of the ions on the H_2O molecule. For anions the hydration is slight and the depolymerisation increases with increasing radius. For kations both actions increase with diminishing radius. In (ii) the 3·05 μ band moves towards higher $\nu\nu$ and the 6·31 μ band towards lower $\nu\nu$; in (iii) both bands move towards lower $\nu\nu$. W. J.

3863. Optical Constants of the Cu-Ni Alloys. H. Lowery, J. Bor and H. Wilkinson. *Phil. Mag.* 20. *pp.* 390–409, *Aug.*, 1935.—The optical constants of the Cu-Ni alloys have been measured by a polarimetric method for twelve specimens for the wave-lengths 5780, 5461 and 4358 Å. Measurements for each specimen have been repeated three times, and consistent results obtained. Stress is laid on the method of polishing adopted which aims at the production of a very thin flowed layer. Curves of the constants n, K, R, nK, and $n^2 - K^2$ against atomic percentage composition for the three wave-lengths are shown and discussed, and certain of their features pointed out. AUTHORS.

***3864. 200-Inch Telescope Disc. G. V. McCauley.** *Soc. Glass Technol., J.* 19. *pp.* 156–166, *June*, 1935.—This paper deals with the general method employed at the Corning Glass Works for casting large telescope discs. Reasons for the choice of method are cited and the essential details given of the several steps in manufacture. A list is included of the large discs already produced by the method explained. AUTHOR.

See also Abstracts 3793, 3847, 3849, 3980.

SPECTROSCOPY.

3865. H.F. Spectrum of Mercury Vapour. N. B. Bhatt. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 891–904, *June*, 1935.—Simple circuits for the efficient production of h.f. discharges and results of spectroscopic investigation of the two types are given. The results lend evidence to the suggestion that the electrostatic produces a greater p.d. than the electromagnetic discharge, as the former brings forth higher excitation lines. The intensity modifications in the h.f. and the arc spectra are given in a table and are found to agree with previous workers. AUTHOR.

3866. Far U.V. Spectra of Zinc, Cadmium and Mercury. L. and E. Bloch. *Comptes Rendus*, 201. *pp.* 137–139, *July* 8, 1935.—An oscillating discharge in an electrodeless tube is used as source of excitation. The results for Hg are in good agreement with those of Carroll [see Abstract 1354 (1926)]. For Zn and Cd between 1330 and 210 Å there is marked similarity in spectra; both are relatively weak; an intense group occurs at 478–425 Å for Zn and at 550–500 Å for Cd and these are attributed to fundamental doublets of Zn IV and Cd IV. The quadruplets of Zn IV and Cd IV were found by examining the region 1300–1600 Å. W. R. A.

3867. Far U.V. Spectrum of Exploded Wires. G. Vaudet and R. Servant. *Comptes Rendus*, 201. *pp.* 195–197, *July* 16, 1935.—The wire is held vertical in a glass globe attached to the spectrograph and evacuated. The explosion is caused by discharge of a $0{\cdot}64\ \mu$F condenser charged to 50 kV. The light is very brilliant, exposure time being only 20 μ. sec. The spectrum consists of lines without continuous background, and the lines are principally spark lines, values for aluminium being quoted. It is necessary that supports for the wire be of the same metal. **Errata,** *ibid. p.* 460, *Aug.* 19, 1935. F. S.

3868. Spectrum of Molybdenum V. M. W. Trawick. *Phys. Rev.* 48. *pp.* 223–226, *Aug.* 1, 1935.—The spectrum of Mo V has been excited in a vacuum spark and photographed with a vacuum spectrograph. With the aid of the irregular doublet law applied to the Sr I-like isoelectronic sequence, lines involving combinations of $4d^2\ {}^3(FP)$, $4d5s\ {}^{1,\ 3}D$, $4d5d\ {}^1(PD)$, and $4d5d\ {}^3(DF)$ with $4d5p\ {}^{3,\ 1}(F^\circ D^\circ P^\circ)$ and $4d4f\ {}^3(G^\circ F^\circ)$, and lying in the spectral region from 2100 Å to 400 Å have been identified. Estimates of the absolute term values have been made from a Moseley diagram. AUTHOR.

3869. Near Infra-Red Spectrum of Benzene-d$_6$. R. B. Barnes and R. R. Brattain. *J. Chem. Phys.* 3. *pp.* 446–449, *Aug.*, 1935.—The transmission spectrum of C_6D_6 has been studied from 1μ to $13{\cdot}25\mu$ and the shifts of three of the four infra-red active vibrations have been determined. The results obtained are in substantial agreement with the assumption of a plane symmetrical molecule as outlined by Wilson [see Abstract 2910 (1934)]. Measurements on C_6H_6 and thipohene extending from 1μ to 15μ are also presented. AUTHORS.

3870. Platinum Isotopes and Their Nuclear Spin. B. Venkatesachar and L. Sibaiya. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 955–960, *June*, 1935.—An examination of the hyperfine structure of some ten lines in the arc spectrum of Pt has led to the determination of the istopic constitution and the nuclear spin of this element. The isotopes are 196 (18), 195 (9), 194 (7) and 192 (1). The relative abundance of the isotopes will be checked by microphotometric study. The nuclear spin of the odd isotope 195 is $\frac{1}{2}\,\dfrac{h}{2\pi}$. The isotopic displacement is observed to be positive. AUTHORS.

3871. Hyperfine Structure of Europium. H. Casimir. *Physica*, 2. *pp.* 719–723, *July*, 1935. *In German.*—The hyperfine structure terms of some lines of Eu have been found by Schüler and Schmidt [see Abstract 2553 (1935)] to deviate from the interval rule. The author shows that the deviations may be explained quantitatively by the assumption that the nucleus has an electric quadripole moment. J. E. K.

3872. Hyperfine Structure of the Mercury Triplet 6^3P_{012}-7^3S_1 in Optical Excitation. Emily E. Boggs and H. W. Webb. *Phys. Rev.* 48. *pp.* 226–232, *Aug.* 1, 1935.—The relative intensities of the hyperfine structure components of λλ 5461, 4358 and 4047 in optically excited mercury vapour are computed on the basis of Schüler and Keyston's term analysis with the assumption of complete absorption of λ 2537 and slight absorption of λ 4538. The computations are tested experimentally by photographing and measuring the intensities of the hyperfine structure of the spectrum emitted by mercury vapour in a quartz resonance cell which is optically excited by a low-pressure mercury glow discharge in a helical quartz tube. The observations agree well with the calculations and show in particular that the two-stage excitation process enhances the intensity difference between components due to isotopes of different abundance. J. E. K.

3873. Hyperfine Structure in Silver. H. Hill. *Phys. Rev.* 48. *pp.* 233–237, *Aug.* 1, 1935.—Twenty lines in the visible spectrum, λ 7688 in the infra-red, and the two resonance lines λ 3383 and λ 3281 were studied by means of a hollow kathode source and Fabry-Pérot interferometers. All lines in the visible were found to be simple in agreement with the findings of other investigators. λ 7688 was found to be a very broad line and lines λ 3383 and λ 3281 were each found to be double with the weaker component on the longer wave-length side. Photographic plates measured gave an average of 0·055 cm.$^{-1}$ for the separation in λ 3383 and 0·056 cm.$^{-1}$ in λ 3281. It is concluded that the doubling of these lines is due to a splitting of the 5*S* level because of nuclear spin which is probably 3/2. AUTHOR.

3874. Influence of Chemical Atmosphere on the Second Positive Group of Nitrogen. M. Duffieux. *Comptes Rendus*, 201. *pp.* 197–198, *July* 16, 1935.—An explanation is proposed of the observation that the distribution of intensity between the bands of the second positive group of N_2 in the post-luminescence of NO_2 is different from that observed in air or in pure nitrogen. F. S.

3875. Band Spectra of the Halogens in the Positive Point Discharge. A. Campetti. *Accad. Sci. Torino, Atti*, 70. 4. *pp.* 618–631, 1934–1935.—The results obtained do not allow of a definite conclusion concerning the origin of the continuous portion and of many of the isolated bands observed in the emission from the halogens. Since, however, the continuous portion is greatly extended when the point discharge is used, it seems not improbable that this is due to emission by electronic affinity. The lengths of the bands decrease regularly in passing from Cl to Br to I. This observation is correlated with the values of the ionisation potential, these also diminishing in the same order. It is considered that the bands may be regarded as the spectra of recombinations between ions or between ions and neutral elements (atoms or molecules). T. H. P.

3876. Band Spectrum of CaH. Part III. B. Grundström. *Zeits. f. Physik*, 95. 9–10. *pp.* 574–587, *July* 1, 1935.—Observations of $C\ {}^2\Sigma \rightleftharpoons X\ {}^2\Sigma$ (0, 0) band, λ 3534, in emission with high dispersion

(0·6 Å/mm.) and at various pressures (10 mm. to several atmospheres) established doublet structure and ascribed the break-off at $K' = 10$ to predissociation. The perturbations are determined from observations of the band in absorption (dispersion 5 Å/mm.). In a vacuum furnace (construction described) the band first appears at 1100° C., and is developed to $K' = 28$, with an overlying weak (1, 1) band, at 1300° C. Use of glass prevents good observation of (1, 0) band, λ 3368. The perturbations are interpreted with aid of potential curves and compared with those in a corresponding CaD band [see Abstract 750 (1935)]. The largest perturbation in C $^2\Sigma$ ($v = 0$) occurs at $K = 11$, which is near dissociation limit of D $^2\Sigma$; others, at $K = 22$ and 28, may possibly be related to high-K perturbations in D → X bands, which, however, may be caused by A $^2\Pi$ or B $^2\Sigma$. [For Part II see Abstract 3263 (1932).] W. J.

3877. Infra-Red Absorption Spectrum of Solid Hydrogen Chloride. P. E. Shearin. *Phys. Rev.* 48. *pp.* 299–301, *Aug.* 15, 1935.—The infra-red absorption spectrum of solid HCl has been studied in the region of 3·7 μ with the aid of an echellette grating. The band is composed of a series of fairly broad lines, and if the centre is taken to be the line at 2669 cm.$^{-1}$ the remaining lines taken in pairs can be grouped about this line with approximately equal spacings. Thus it appears that the band differs from the band in gaseous HCl in that it has a zero line.

AUTHOR.

3878. Absorption Spectra in the Schumann Region. H. J. Hilgendorff. *Zeits. f. Physik,* 95. 11–12. *pp.* 781–788, *July* 12, 1935.—A fluorspar vacuum spectrograph was used for the region 2000 to 1300 Å. A series of bands between 2001 and 1789 Å with a wave-number difference of 450 cm.$^{-1}$ was found for prussic acid. In ethylene, a series of diffuse bands showing predissociation were found between 1973 and 1762 Å, the heat of dissociation being 158·6 cal./mol. Hydrazine shows complete absorption in the Schumann region, but bands between 2540 and 2278 Å were found with a quartz spectrograph, giving a heat of dissociation of 122·4 cal./mol. The accuracy of observation was checked with the known spectrum of ammonia. F. S.

3879. Band Spectrum of Pb_2 in Absorption and Emission. E. N. Shawhan. *Phys. Rev.* 48. *pp.* 343–346, *Aug.* 15, 1935.—A band system has been observed when light is absorbed by lead vapour heated to about 1400° C. The same band system has also been found in emission. Some ninety band heads have been located between the wave-lengths of 4600 and 5200 Å. The bands are degraded toward the red. The vibrational analysis has been made, but the complexity of the isotope effect has prevented a rotational analysis. Within the error of observation the heads are represented by the formula:

$$\nu = 19{,}570\cdot8 + 159\cdot22(v' + \tfrac{1}{2}) - 0\cdot882(v' + \tfrac{1}{2})^2 + 0\cdot00518(v' + \tfrac{1}{2})^3 - 256\cdot5(v'' + \tfrac{1}{2}) + 2\cdot96(v'' + \tfrac{1}{2})^2.$$

Fairly conclusive evidence is presented for the ascription of this band system to the molecule Pb_2. AUTHOR.

3880. Far U.V. Absorption Spectra and Ionisation Potentials of Benzenes C_6H_6 and C_6D_6. W. C. Price and R. W. Wood. *J. Chem. Phys.* 3. *pp.* 439–444, *Aug.*, 1935.—These spectra are photographed between λλ 2000 and 1000 in dispersion 2·3 Å/mm. with a Lyman continuum tube as source and measured against H_2 wave-lengths. Each has (i) strong continuum starting at λ 1840 and fading out near λ 1600, (ii) strong narrow red-degraded bands from λ 1600 to λ 1360, (iii) continuum and diffuse bands beyond λ 1360. In (ii) a non-bonding electron is excited; the strong bands (" vibrationless " transitions) form two Rydberg series whose common limit gives an ionisation potential of $9 \cdot 190 \pm 0 \cdot 005$ V for C_6H_6 and $0 \cdot 0003$ V higher for C_6D_6; these bands indicate electronic multiplicity in each state, and show small isotopic shifts; the excited states have vibrational frequencies 677 and 968 cm.$^{-1}$ for C_6H_6 and 630 and 926 cm.$^{-1}$ for C_6D_6—the modes of vibration are discussed. In (iii) a bonding electron is excited; the isotopic shifts are larger; from these bands a second ionisation potential of C_6H_6 is estimated at $11 \cdot 7 \pm 0 \cdot 3$ V.

W. J.

3881. Hyperfine Structure of HgH Bands. Part II. S. Mrozowski. *Zeits. f. Physik*, 95. 7–8. *pp*. 524–538, *June* 26, 1935.—The complex structure of the visible HgH band lines [see Abstract 1241 (1932)] is investigated under improved conditions and the observations are extended to the ultra-violet bands. The lines of the $^2\Pi \rightarrow {}^2\Sigma$ band system have a fourfold structure which may be ascribed to the four even Hg-isotopes 198, 200, 202, and 204. Five approximately equidistant components are observed in the case of lines of the $^2\Sigma^1 \rightarrow {}^2\Sigma$ system, the fifth lying in the place of the isotope 196. The size of the separations does not agree with the usual isotope formula, an isotope displacement still remains after the rotation and vibration effects are deducted. The intensity relations of the components are different in both band systems and are not proportional to the isotope concentration. The deviations from proportionality are considered to be caused by the splitting into several components of the lines due to the odd Hg isotopes 201 and 199.

J. E. K.

3882. Perturbations and Predissociation in the b^3 Σ State of CO. L. Gerö. *Zeits. f. Physik*, 95. 11–12. *pp*. 747–751, *July* 12, 1935. —Dieke and Mauchly's analysis of CO third positive bands showed that the levels of the upper state b $^3\Sigma$ have many strong perturbations due to consecutive vibrational levels of another $^3\Sigma$ state (probably a′), and gave $B_0' = 1 \cdot 89$ cm.$^{-1}$, a provisional value known to be too low since no b $^3\Sigma$ level appeared to be quite unperturbed. Applying his former procedure of plotting observed values of $B' - B''$ against K [see Abstracts 2121 and 2582 (1935)] the author determines the perturbations and the unperturbed levels exactly. The curve (i) leads to $2 \cdot 058$ cm.$^{-1}$ as the unperturbed value of B_0', and (ii) shows that with increasing K the perturbations become closer together and tend towards a convergence point between 89950·6 and 90181·1 cm.$^{-1}$ above the ground state X $^1\Sigma$. This is very near the predissociation limit observed in the Ångström bands. The eventual identity of the causes of the predissociation and perturbations is discussed.

W. J.

3883. Rotational Analysis of the S_2-Bands. E. W. van Dijk and A. J. Lameris. *Physica*, 2. *pp*. 785–786, *Aug*., 1935. *In English*. —A new analysis of the S_2-bands is given, the results of which do not agree with those of Naudé and Christy and of Badger [see Abstracts 2281 (1931) and 1389 (1934)]. The wave function of the S_2-molecule is symmetric in the nuclei; the nuclear distance in the final state is 1·73 Å.

AUTHORS.

3884. Absorption Band Spectrum of Selenium. T. E. Nevin. *Phil. Mag*. 20. *pp*. 347–354, *Aug*., 1935.—The absorption band spectrum of Se_2 has been photographed and measured. A vibrational analysis is given and large perturbations of the heads belonging to a number of levels have been found. An isotope effect has been observed and good agreement is found between the observed and calculated positions of the heads. AUTHOR.

3885. Extension of the Rh I-Like Isoelectronic Sequence to the Spectrum of Ag III. W. P. Gilbert. *Phys. Rev.* 48. *pp.* 338–342, *Aug.* 15, 1935.—The spark spectrum of Ag has been photographed and measured in the region from 500 to 3000 Å. To assist in the identification of Ag III lines, the spectrum of Ag from the hollow kathode discharge in an atmosphere of He was photographed from 500 to 2600 Å. With the already reported separation of 4607 cm.$^{-1}$ for the ground state, $4d^9\ {}^2D_{2\frac{1}{2},\ 1\frac{1}{2}}$, as a basis and by employing the above method of distinguishing the radiations, it has been possible to establish 55 terms originating from the $4d^9$, $4d^85s$, and $4d^85p$ configurations and to classify a total of 257 lines. Approximate term values have been obtained by extrapolation of a Moseley diagram for the elements of this sequence. The value obtained for the lowest state of Ag III with respect to the $4d^8\ {}^3F_4$ state of Ag IV is 291,250 cm.$^{-1}$, which corresponds to an ionisation potential of 35·9 V. AUTHOR.

3886. Oscillation and Rotation Spectrum of the Molecule HD. G. C. Wick. *Accad. Lincei, Atti*, 21. *pp.* 708–714, *May* 19, 1935.—Since the nuclei of the molecule HD are not identical, the latter should give a rotation-oscillation spectrum although in view of the symmetry of the electronic structure the spectrum must be very weak. The wave mechanics theory of the oscillation bands is developed and it is shown that the expected intensity is possibly observable. W. S. S.

3887. Frequencies of Vibration of C_2H_4. J. M. Delfosse. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 114–128, *June* 28, 1935.—Mathematical. W. R. A.

3888. Frequencies of Vibration of Molecules of the Type X_6Y_6. C. Manneback. *Ann. Soc. Sci. de Bruxelles*, 55. *pp.* 129–159, *June* 28, 1935.—The small harmonic oscillations of a molecule X_6Y_6, having hexagonal symmetry are determined mathematically by the aid of "symmetrical" coordinates. W. R. A.

3889. Modes of Vibration of Halogen Derivatives of Ethane, X—CH$_2$—CH$_2$—X. Hua-Chih Cheng and J. Lecomte. *Comptes Rendus*, 201. *pp.* 50–52, *July* 1, 1935.—Certain modes of vibration are identified partly with Raman frequencies and partly with infra-red absorption maxima for the compounds X—CH$_2$—CH$_2$—X (where X = Cl, Br, I). Six fundamental frequencies were found for each derivative at frequencies less than 1000 cm^{-1}. By combining infra-red and Raman data it is possible to find each fundamental doubled, giving twelve in all, and it is concluded that *cis* and *trans* isomers might exist. Which frequencies will appear in each type of spectrum is indicated and the polarisability of the Raman frequencies is also indicated from symmetry considerations. A well-defined frequency in the infra-red spectra is displaced systematically from 1243 to 1128 cm^{-1}. in passing from 1·2 di-chloro- to 1·2 di-iodo-ethane. W. R. A.

3890. Energy Levels of H_2 Spectrum. Part III. I. Sandeman. *Roy. Soc. Edinburgh, Proc.* 55. 1. *pp.* 72–83, 1935.—On the basis of Dunham's solution of the wave-equation for a diatomic molecule, as used previously [see Abstract 3524 (1935)], molecular constants of the ground state of H_2 are calculated from Jeppesen's observational data [see Abstract 4517 (1933)]. Those for the ground state of H_2^+ are also predicted, the

7.38
.935

procedure being to calculate by Jaffé's method the energy for a number of values of r close to r_e and then to obtain the simplest formula expressing it as a function of r. Results are

	ω_e(cm^{-1}.)	B_e(cm^{-1}.)	r_e(Å)
Ground state $1s\sigma\ {}^2\Sigma$ of H_2^+ :	2321·5	29·93	1·055
,, ,, $1s\sigma^2\ {}^1\Sigma$ of H_2 :	4449·970	60·95363	0·740

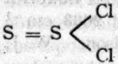
The potential energy expansions for the $1s\sigma^2\ {}^1\Sigma$ and $1s\sigma\ 2s\sigma\ {}^3\Sigma$ states of H_2 resemble that for the ground state of H_2^+, but cannot, apparently, be represented by any compact expression. Clarke's modification [see Abstract 1660 (1935)] of Morse's $\omega_e r_e^3$ rule is discussed. W. J.

3891. Molecular Constants and Potential Energy Curves for Diatomic Molecules. M. L. Huggins. *J. Chem. Phys*, 3. *pp.* 473–479, *Aug.*, 1935.—By using the function $U = Ce^{-a(r-r_e)} - C'e^{-a'(r-r_e)}$ with $C = 10^{-12}e^{-a(r_e-r_{12})}$, and taking $a = 6 \cdot 0 \times 10^{8}$ cm^{-1}, r_{12}values calculated from the band spectrum constants are nearly the same (1·46 Å) for all except highly excited states of all diatomic molecules containing only elements in the first row of the periodic table and having 12 or more electrons. This indicates that the repulsive term is nearly the same in all of these cases. This relation permits the calculation from experimental values of two of the molecular constants (*e.g.*, ω_e and $\omega_e x_e$) the magnitudes of others (*e.g.*, r_e, B_e and a). Calculated values of $\omega_e y_e$ and $\omega_e z_e$ are invariably small but not zero. The dissociation energy is (empirically) about 0·8 $(C' - C)$, calculated using $a = 4 \cdot 0 \times 10^8$ cm^{-1}. AUTHOR.

3892. Absorption Spectrum of Hydrogen Peroxide Vapour. R. S. Sharma. *Acad. Sci. Proc., U.P. India,* 4. 1. *pp.* 51–58, *Aug.*, 1934.—The absorption spectrum of H_2O_2 vapour shows a sharp continuous absorption beginning at 2055 Å. This corresponds to 139·1 k.cal. The recombination spectrum shows a continuous emission beginning at 4800 Å. This corresponds to 59·6 k.cal. The sharp cut at 2055 Å is interpreted as due to the photochemical dissociation $H_2O_2 + h\nu = 2H + O_2$, where $h\nu = 136 \cdot 1$ k.cal. The recombination spectrum is interpreted as being due to the energy emitted in the process $H + HOO = H_2O_2 + h\nu$ (59·6 k.cal.). The slight reduction of cupric oxide lends some support to the view that atomic hydrogen is formed in the photochemical dissociation of the peroxide vapour. AUTHOR.

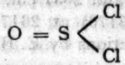
3893. Application of the Franck-Condon Principle to Continuous Absorption Spectra of Diatomic Molecules. H. Trivedi. *Acad. Sci. Proc., U.P. India,* 4. 1. *pp.* 59–70, *Aug.*, 1934.—The homogeneous absorption spectrum of diatomic molecules has been considered by Condon. Certain difficulties appear in that treatment. They have been pointed out. The problem is re-considered from the point of view of wave mechanics. The potential energy of the molecule in the upper unstable electronic state is taken to be given by $A + De^{-2ar}$. A wave equation of the molecule for this state is formed and its solution shows that the ψ function has some value, different from zero, for all values of energy $(E - A)$ greater than zero, where E = energy constant. It is shown that the beginning of absorption gives the heat of dissociation of the molecule and the absorption will extend unrestricted to infinity. AUTHOR.

3894. Absorption Spectra of S_2Cl_2 and $SOCl_2$ Vapours. H. Trivedi. *Acad. Sci. Proc., U.P. India,* 4. 3. *pp.* 263–268, *Feb.*, 1935.—Absorption spectra of S_2Cl_2 and $SOCl_2$ were studied. Both substances show, at low pressures, two regions of continuous absorption separated by a region of retransmission. Long wave-length absorption begins at 2740 Å and 2135 Å in the case of S_2Cl_2, whereas for $SOCl_2$, it begins at 2980 Å and 2040 Å. These shift towards red with increasing pressure. The difference between the energies corresponding to these beginnings is equal to that of $^3P - {}^1D$ of S in the case of S_2Cl_2 and $^3P - {}^1D$ of O in the case of $SOCl_2$. It is shown that the constitution of these molecules is as



$S = S\langle^{Cl}_{Cl}$

and



$O = S\langle^{Cl}_{Cl}$

and the binding is electronic. AUTHOR.

3895. Phosphorescence of Nitrogen Peroxide. Intensity of Bands of Second Positive Group of N_2. M. Duffieux. *Comptes Rendus*, 201. *pp.* 53–55, *July* 1, 1935.—The author has studied the phosphorescence of nitrogen peroxide in a tube in which a discharge from a rectified a.c. is passed across a stream of the gas. Three colours were seen in the discharge, greenish yellow, violet and yellow orange, as already described by Zenneck and Strasser in O_2-N_2 mixtures. Arrangements were made which isolated the phosphorescence and discharge spectra and which also showed the development of the spectra. The discharge spectrum showed, on the one hand, a continuous band plus oxygen lines, nitrogen lines and faint first positive N_2; and, on the other hand, the second positive group of N_2 in the violet and ultra-violet together with the β and γ groups of NO. The phosphorescence spectrum showed besides a continuous band in the longer waves the second positive group of N_2 and the γ group of NO in the violet and ultra-violet. The distribution of intensity in the second positive group of N_2 is the same in the discharge as in the phosphorescence. But as compared with the distribution in air or nitrogen it is striking that in the discharge tube the transitions are strictly limited to the most probable, *i.e.*, those very near the Condon summit. J. E.

3896. Influence of Temperature on the Raman Bands 510-780 cm.$^{-1}$ of Water. G. Bolla. *N. Cimento*, 12. *pp.* 243–246, *April*, 1935. —From spectrograms of the Raman spectrum of water at temperatures ranging from 28° to 92° it is shown that contrary to a recent observation of M. Magat the Raman bands 510 and 780 cm.$^{-1}$ do not disappear in the neighbourhood of 40° C. W. S. S.

3897. NO^+ Radical. W. R. Angus and A. H. Leckie. *Faraday Soc., Trans.* 31. *pp.* 958–962, *Aug.*, 1935.—Raman effect measurements on nitrosyl sulphate ($NO.HSO_4$) and on nitrosyl perchlorate ($NO.ClO_4$) [see Abstract 3070 (1935)] indicated that both these substances were ionic and contained an NO^+ group. That $NO.HSO_4$ is conducting was demonstrated by passing an electric current through a saturated solution of $NO.HSO_4$ in H_2SO_4 between a Pt anode and a Fe kathode. The generation of an intense brown colour ($FeSO_4.NO$) in the kathode limb showed that NO was being discharged there. Data on the ionisation potential of NO are discussed. Quantitative conductivity measurements on $NO.HSO_4$ and $NO.ClO_4$ did not yield results of high accuracy. Additional proof of the existence of the NO^+ radical in these compounds is given by a comparison of the frequencies of isoelectronic diatomic molecules. W. R. A.

3898. Raman Spectrum of Heavy Benzene C_6D_6. R. W. Wood. *J. Chem. Phys.* 3. *pp.* 444–445, *Aug.*, 1935.—A 30 × 0·6 cm. straight tube containing 1·5 cm^3. of fluid C_6H_6 is mounted vertically, pyrex window downwards, over a total-reflection prism, and irradiated, first with the full unfiltered radiation from a vertical quartz Hg lamp for 24 hr. to destroy troublesome fluorescence, and then with λλ 4358 and 4046 in turn filtered from the same lamp. Excellent Raman spectra are thus obtained. Corresponding shifts observed with the two benzenes are ($\Delta\nu$ cm.$^{-1}$) :—

C_6H_6 : 605 849 991 1178 $\underbrace{1584\ 1606}$ 2947 3042 3062 3157 3176 3573 3627

C_6D_6 : 581 662 945 873 1548 2266 2293 2575 3052 3108

In C_6D_6 are also found faint lines at 1000 and 2031 cm.$^{-1}$ and a doubtful pair (apparently corresponding to C_6H_6 3176) at 2617 and 2663 cm.$^{-1}$ The observations confirm theoretical predictions by E. B. Wilson. W. J.

3899. Raman Spectra of Arsenic Trichloride and of Its Mixtures. A. E. Brodskii and A. M. Sack. *J. Chem. Phys.* 3. *pp.* 449–452, *Aug.*, 1935.—The Raman spectra from mixtures of $AsCl_3$ with benzene, CCl_4, methyl and ethyl alcohol have been investigated. The strong deviations from additivity have been observed for $AsCl_3$ in alcohols. The shifts are correlated with the strength of the bond As — Cl. A computation of the constants of the molecule $AsCl_3$ is made which agrees with electronographic data. The geometrical configuration of the molecule $AsCl_3$ in mixtures undergoes only a slight deformation, but the bond As — Cl is considerably weakened in alcoholic solutions. AUTHORS.

3900. Raman Spectrum of a Ferromagnetic Oxide. L. F. Bates and H. E. Hogwood. *Phys. Soc., Proc.* 47. *pp.* 877–878, *Sept.* 1, 1935.—An attempt has been made to determine whether the ferromagnetic oxide Cr_5O_9 exhibits a Raman spectrum. No trace of such a spectrum was found. AUTHORS.

***3901. Device for Selecting Monochromatic Light. E. M. Brumberg.** *Comptes Rendus de l'Acad. des Sciences. U.S.S.R.* 2. *pp.* 464–469, *June*, 1935. *In German.*—The arrangement consists of two right-angled prisms forming a rectangular block, between which a layer of a fluid of suitable dispersion is introduced. A sharp boundary to the transmitted light is produced by total reflection. Alternatively a transverse plate is introduced in a fluid at a suitable angle. By using appropriate substances, the author has selected spectral regions as narrow as 20 Å. The method is specially useful for selecting limited regions in the ultra-violet; illustrations show the use of different pairs of substances. T. L. M.

***3902. Vacuum Monochromator and Spectrograph with Quartz or Fluorite Optical System for Regions 0·700 μ to 0·160 μ (Quartz) and 0·700 μ to 0·130 μ (Fluorite). C. Leiss.** *Zeits. f. Physik*, 95. 11–12. *pp.* 778–780, *July* 12, 1935.—An instrument is described which can be used as a monochromator and constant deviation spectrograph both with a quartz and with a fluorspar optical system so that investigations may be carried out with it in the Schumann region. The focusing of the two objectives is effected by the same drum which is graduated in wave-lengths; the adjustment of the dispersion systems is made by a similarly calibrated drum. J. E. K.

***3903. Prism Spectrographs with Prism Mountings Automatically Adjusted to Minimum Deviation. H. E. White.** *J.O.S.A.* 25. *pp.* 241–243, *Aug.*, 1935.—A two prism Littrow spectrograph is described in which the 60°-prism is rotated about the centre of the face nearer to the lens. The 30°-prism is mounted on another table, coupled to the first with 1 : 2 ratio, and rotating about the lower front corner. A method of adjustment is described involving light reflected from the inner surface of a Cornu prism, and a more general method for glass prisms. A modification for instruments with two 60°-prisms is also given. F. S.

3904. Detection of Traces of Hydrogen and Neon in Helium. P. L. Günther and F. A. Paneth. *Zeits. f. phys. Chem.* 173. *Abt.A.* 6. *pp.* 401–411, 1935.—Following Paneth and Peters's micro method of detecting small amounts of He [see Abstract 2439 (1928)] the spectroscopic detection of H_2 and Ne in He has been worked out. In quantities of He not exceeding 10^{-7}c.c., H_2 is detectable only if it amounts to at least 0·1 %, corresponding with 10^{-16} c.c. By this method the air near the earth's surface is found to contain less than 2×10^{-4} % of H_2. Ne may be detected in 10^{-7} c.c. of He if its amount is 0·002 %, corresponding with 2×10^{-12} c.c. or 2×10^{-15} gm. T. H. P.

See also Abstracts 3721, 3722, 3723, 3727, 3728, 3730, 3750, 3773, 3942.

VISION.

3905. Four-Colour Theory of Colour Vision. J. F. Schouten. *K. Akad. Amsterdam, Proc.* 38. 6. *pp.* 590–603, 1935.—Describes a modification of Hering's theory and tests quantitatively the extent to which it gives results in accordance with the experimental facts, particularly as regards the saturation discrimination throughout the spectrum, the colour discrimination curve and the results of experiments on colour recognition. In a final section, the concordance of the present theory with the trichromatic theory is discussed. J. W. T. W.

3906. Fatigue of the Extrinsic Ocular Muscles while Reading under Sodium and Tungsten Light. M. Luckiesh and F. K. Moss. *J.O.S.A.* 25. *pp.* 216–217, *July,* 1935.—The average amplitude of convergence was determined before and after an hour's reading (*a*) under 5 ft.-candles of sodium light, and (*b*) under the same illumination of tungsten filament light. In both cases a small decrease in the amplitude of convergence, of the order of 7 %, was observed after reading, the difference between the decrease for sodium and for tungsten light being unimportant. W. S. S.

X-RAYS.

3907. Temperatures of Continuously Operated Mobile X-Ray Focal Spots. J. W. M. DuMond, B. B. Watson and B. Hicks. *Rev. Sci. Instruments,* 6. *pp.* 183–193, *July,* 1935.—A " mobile " focal spot is defined as one which moves cyclically in a closed path relative to the target surface, irrespective whether the spot or target moves. The paper treats the case where the spot is energised continuously so that a steady state of thermal oscillations is set up, and the solutions refer only to conditions after the steady state is attained. The calculations refer to a uniform focal spot with sharp boundaries and the heat flow through the target is assumed to be normal to the target face. Curves of the ratio of permissible energy input for fixed and moving spots are given, and the physical interpretation of the mathematical results is discussed. G. E. B.

3908. Characterisation of Technical X-Ray Tubes. H. Behnken and H. Nitka. *Phys. Zeits.* 36. *pp.* 459–463, *July* 1, 1935. *From the Reichsanstalt.*—The Al-equivalent of glass windows of X-ray tubes is only definite below 31 kV. Beyond this it is a function of the voltage. It is also shown that the Al-equivalent of Lindemann-glass windows can be found from the slope of the ordinary transparency-curve of aluminium. The reciprocal of the differential coefficient is, for thin filters nearly proportional to the thickness of the filter, and by extrapolating back to zero thickness the required value can be found. Differences in the Al-equivalents of the windows of two tubes may be found from the transparency curves. G. E. B.

***3909. Casting Molybdenum Buttons in Brass, for Water-Cooled Targets in X-Ray Tubes. F. H. Trimble.** *Rev. Sci. Instruments,* 6. *p.* 216, *Aug.*, 1935.—An electric arc furnace, for casting molybdenum buttons in brass, is described, which can be assembled from apparatus available in any laboratory. A water-cooled target, prepared by this method, has been used successfully by the writer in a demountable X-ray tube. AUTHOR.

3910. Dispersion of X-Rays by Nickel. Part II. J. Oumanski and W. Wexler. *Phys. Zeits. d. Sowjetunion,* 7. 3. *pp.* 336–342, 1935. *In French.*—In an earlier paper [see Abstract 767 (1935)] the authors discussed the dispersion of X-rays by nickel as a function of the angle of dispersion, and established the curve of the atomic factor of nickel. The present paper studies the variation of intensity with temperature. The line (311) was studied with the aid of a Geiger-Müller counter at temperatures of 290, 480, 590, 690 and 740 Å. At 480° and 590° the intensities agreed with those calculated on the Waller formula, but between 590° and 690° the intensity falls off rapidly. This may be explained on the assumption that in passage from the ferromagnetic to the paramagnetic state the inter-atomic forces suffer a weakening. This hypothesis is not contradictory to the variation of a number of physical properties at the Curie point, and conforms to the theory of Heisenberg. G. E. B.

3911. Scattering of Hard Radiation by Bound Electrons. W. Franz. *Zeits. f. Physik,* 95. 9–10. *pp.* 652–668, *July* 1, 1935.—The scattering due to electrons for the case of $h\nu \gg a\,E_0$ is recalculated and the formula obtained is compared with that of Casimir. The logarithmic member of Casimir's formula is found to be correct. Application of the scattering formula to atoms with several electrons shows that for the hardest rays the term in the dispersion formula involving a^2 is more important than the logarithmic term. The scattering coefficient is always less than that calculated from the Klein-Nishina formula, the differences ranging up to $1 \cdot 5\ \%$. [See also Abstract 4603 (1934).] A. W.

3912. Kathode-Ray Measurement of Absolute Probability of K-Electron Ionisation of Silver. J. C. Clark. *Phys. Rev.* 48. *pp.* 30–42, *July* 1, 1935.—Ross's balanced-foils method was used to separate the Kα-quanta from the thin Ag-foil target radiation. The ionisation current produced by absorbing a known fraction of the X-ray quanta in a standard ionisation chamber was measured and the energy absorbed computed. The number of Ag K-ionisations per bombarding electron was then calculated, after making the necessary target and absorption corrections. The K-electron ionisation cross-section for Ag for 70·0 kV electrons was found to be $\Phi\ (\mathrm{U}) = (4 \cdot 80 \pm 0 \cdot 43) \times 10^{-23}\ \mathrm{cm}^2$. The results of other workers are standardised relative to this value and the experimental data thus obtained are compared with classical quantum and wave-mechanical theories. W. E. P.

3913. X-Ray Photolysis of Hydrogen Peroxide. D. den Hoed and C. W. F. Spiers. *Zeits. f. phys. Chem.* 173. *Abt.A.* 6. *pp.* 412–414, 1935.—Very dilute H_2O_2 solutions (0·02-0·05M) were subjected to the action of hard X-rays (100-200 kV, wave-length 0·06–0·5 Å). The amounts of H_2O_2 decomposed for different initial concentrations, as determined by titration with dilute ceric sulphate solution, were found to depend on the energy intake but not on the voltage. T. H. P.

3914. Blackening of Photographic Plates by Long Wave-Length X-Rays. F. R. Hirsh, Jr. *J.O.S.A.* 25. *pp.* 229–230, *Aug.*, 1935.—The density, exposure-time curves for X-rays of wave-length 4–6 Å, exhibit an initial region of linearity whose extent increases with the wave-length. At about 6 Å, the shape of the density, exposure-time curve suggests a tendency towards the familiar shape of the curve for the ultra-violet and visible regions. AUTHOR.

3915. Refractive Index of X-Rays with Grazing Emergence from a Prism. G. Orban. *Zeits. f. Physik,* 95. 7–8. *pp.* 474–485, *June* 26, 1935.—In the first part the theory of transmission of X-rays through an absorbing prism is developed. It is shown that a dependence of refractive index on angle is only to be expected at grazing entry and that in this case the refractive index for the back face of the prism is constant. For grazing exit the value $1 - \mu$ for the back face shows a very small increase with angle. In the second part of the paper measurements are given for a calcspar prism. The refractive index was in agreement with the theory, constant. The assumptions of Jentzsch and Steps that the angle variation of μ found by them with a glass prism is in accord with theory is incorrect since they have ignored the irreversibility of X-rays in an absorbing medium. J. E.

3916. Intensity of X-Ray Reflections from Powders. J. C. M. Brentano. *Phys. Soc., Proc.* 47. *pp.* 932–947, *Sept.* 1, 1935.—The paper refers to determinations of the dispersion of F-values in the range of the L absorption levels in which powder methods were applied to measurements requiring a high degree of accuracy, and discusses the conditions determining quantitative measurements made with microcrystalline powders. The conditions relating to the absorption in a powder layer and the effect of the size of the crystallites on the evaluation of intensities are discussed. Indications are made as to the preparation of suitable particles and as to the use of spacing materials for avoiding the formation of larger units. A detailed discussion is given of the factors determining quantitative measurements by the method of the flat powder layer and by the method of mixed powders. The conditions determining the accuracy of the microphotometric photometry of reflections obtained from a flat layer and the absorption effect in a mixed layer in relation to the absorption in the individual particle are considered. Expressions are derived for evaluating the absorption effect for particles of different absorbing-power. Reference is made to a recent paper by Brindley and Spiers [see Abstract 4833 (1934)] on the development of the method of the flat powder layer and of the method of mixed layers. It is shown that the arrangement which had been described by the writer in an earlier paper is not advisable for accurate measurements. AUTHOR.

3917. M-Series of Elements from Nb to Ag. H. Kiessig. *Zeits. f. Physik,* 95. 9–10. *pp.* 555–574, *July* 1, 1935.—The M-lines of the X-ray spectra of the elements from Nb to Ag are measured with the exception of 43, Ma. The wave-lengths of these lines lie in the region from 20 Å to 80 Å. The qualitative intensity ratios are shown by photometer curves. J. T.

3918. Fine-Structure of X-ray Absorption Edges of Alloys. R. Smoluchowski. *Zeits. f. Physik,* 95. 9–10. *pp.* 588–598, *July* 1, 1935.—The author's method of calculating the fine-structure of X-ray absorption-edges, which was successful in the case of γ-alloys [see Abstract 3080 (1935)], is applied to the case of alloys which possess simple lattices, but whose constituents differ markedly in atomic number. The experimental results are found to agree with the theoretical. The case of CuBe shows the great influence of the atomic number. From the examination of NiO it is concluded that the nature of the binding forces has no effect except in the neighbourhood of the principal edge. Finally the differences between the fine-structures of the absorption-edges of AuCu3 with ordered and random atomic distribution, are studied. J. T.

3919. Ultra-Soft X-Ray Spectroscopy. Part V. M. Siegbahn and T. Magnusson. *Zeits. f. Physik,* 96. 1–2. *pp.* 1–11, *July* 25, 1935. —Continuing their investigations with concave grating spectrographs of high dispersion and resolving power [see Abstract 3541 (1935)] the authors have observed the structure of the $K\alpha$-line of carbon, 44 Å, given by graphites (Acheson, Ceylon, Schungit), coal, lamp-black, charcoal, powdered diamond, certain carbides (Ca_2C, SiC, Cr_7C_3 and Cr + $Cr_{23}C_6$) and carbonates (Na_2CO_3, $MgCO_3$, $CaCO_3$ and $BaCO_3$). The results are shown in spectrograms, photometer curves and other diagrams, and the component wave-lengths, obtained from direct measurement against optical spark-line wave-lengths, are tabulated. For graphite, diamond and the carbides earlier results by the authors and by other investigators [see Abstract 1199 (1934) and 354 (1935)] are confirmed and extended. Carbonates give surprisingly sharp components which are quite different in character from those given by compounds previously studied. W. J.

3920. Calculation of X-Ray Terms According to Heisenberg's Theory on Electron-Holes. G. Araki. *Tokyo B.D. Sci. Reports.* 2. 41. *pp.* 189–216, *July* 5, 1935. *In English.*—The numerical values of K-terms and their screening constants are computed for all atoms. The results are in good agreement with experimental values. [See Abstract 48 (1932).] AUTHOR.

***3921. Structure of K-Lines of Light Elements. A. Hautot.** *Ann. de Physique,* 4. *pp.* 5–87, *July–Aug.,* 1935.—Summarises the present knowledge of soft X-rays and deals with the theory of the concave grating and the best conditions for their use in the investigations of soft X-rays. Descriptions are given of four vacuum spectrographs used in the study of the structure of the K-lines of O, N, C, B and Be. The results obtained by the author and other observers are discussed in connection with Wolfe's modification of Langer's theory of X-ray satellites. W. E. P.

3922. Excitation Potential of X-Ray Satellites in the L-Series. D. Coster, H. H. Kuipers and W. J. Huizinga. *Physica,* 2. *pp.* 870–878, *Aug.,* 1935. *In English.*—It is shown that the doubly ionised state $L_{III}\ M_{IV,\ V}$ which is responsible for the satellites on the short wave-length side of the $L\alpha_1$-line is mainly due to the radiationless transition $L_I \rightarrow L_{III}$ with the ejection of an M-electron. AUTHORS.

3923. Double Electron Transitions in X-Ray Spectra. F. Bloch. *Phys. Rev.* 48. *pp.* 187–193, *Aug.* 1, 1935.—Elementary processes are considered, in which simultaneous transitions of an inner and an outer atomic electron result in the emission of one single light quantum. Considering the nuclear distance of the inner electron as small compared to that of the outer electron, formulæ are developed for the probability of double transitions by dipole radiation. The occurrence of the $CuK\alpha_3$ satellite is given as a possible illustration of the case, where the inner transition alone occurs by dipole emission; a special consideration applies in this connection to the probability of simultaneous inner ionisation and outer excitation. For the case of a forbidden inner transition, the simultaneous emission of a light quantum and an outer electron (radiative Auger effect) is discussed. AUTHOR.

3924. Technique for X-Ray Studies of Substances under High Pressures. L. K. Frevel. *Rev. Sci. Instruments*, 6. *pp.* 214–215, *Aug.*, 1935.—Describes a method for enclosing, under pressure, a crystalline material in a fine capillary tube, and the subsequent examination of the material under different pressures, by a Debye-Scherrer camera. W. E. P.

***3925. Spectrograph for Ultra-Soft X-rays. E. A. W. Müller.** *Zeits. f. Physik*, 95. 11–12. *pp.* 763–768, *July* 12, 1935.—A spectrograph, based on a modification of Prins' expression [see Abstract 3490 (1931)] is described for relative measurements particularly of the intensity distribution inside the lines of soft X-rays. The X-ray tube, slit system and grating holder are combined in one unit. Details of the construction and the adjustment necessary are given, together with one or two typical photographs obtained with the spectrograph. W. E. P.

***3926. Crystal and Slit Systems for X-Ray Monochromatisation and Spectroscopy. G. I. Harper,** *Appendix by* **T. Smith.** *Roy. Soc., Proc.* 151*A*. *pp.* 118–141, *Aug.* 1, 1935.—A quantitative general theory of the use of crystal and slit systems in X-ray physics for the production of monochromatised beams and for the analysis of composite radiations is developed. The corrections arising from slit breadth, slit height, and crystal setting that have to be applied in the interpretation of experimental results are given in detail. The design of slit systems for monochromators and spectroscopes is discussed, and it is pointed out that the optimum design may be very different from that usually adopted.

AUTHOR.

See also Abstracts 3781, 3945.

HEAT.

CALORIMETRY.

3927. Anomalous Specific Heats of Crystals, with Special Reference to the Contribution of Molecular Rotations. R. H. Fowler. *Roy. Soc., Proc.* 151*A*. *pp.* 1–22, *Aug.* 1, 1935. *Bakerian Lecture.*—A general survey is provided of the specific heats of crystalline solids. A theoretical construction of the free-energy function of the solid is given in terms of an assumed model for the atoms or molecules constituting its crystal lattice. From this free energy, the total energy content, specific heat, equation of state, and other related equilibrium properties of the solid can be deduced by differentiation, and specific heats can be submitted easily to comparison with experiment. A description of the present state of the theory of the partial functions of solids and their success or failure in describing the observed facts is given. After a discussion of the various types of anomaly in the specific heat curves not provided for by the simpler versions of the theory, a description of attempts made to explain them is given among which the theory of molecular rotations in solids finds its natural place. Anomalies are classified into three main types, but it is considered that the distinctions may prove later not to be sharp ones. R. S. R.

***3928. Heat Capacities at Low Temperatures. S. Aoyama and E. Kanda.** *Tôhoku Univ., Sci. & Technol. Reports*, 24. *pp.* 116–121, *May*, 1935. *In English.*—A description of an adiabatic calorimeter constructed for the purpose of measuring the heat capacities of liquid and solid compounds at low temperatures. Some results for benzene, toluene, ethyl-ether, phenol and iodobenzene are reported. AUTHORS.

CONDUCTION.

3929. Viscosity and Heat Conduction According to the Geometrical Weight Method. W. S. Kimball. *Phil. Mag.* 20. *pp.* 355–390, *Aug.*, 1935.—The geometrical weight method, which relies on stresses and strains in velocity and ordinary space, has previously been used by the author in studying viscosity [see Abstract 3959 (1933)] and heat conduction in gases [see Abstract 3552 (1935)]. An ellipsoidal distribution is assumed in the former case and a limacoidal in the latter, and the conclusions all rest on Newtonian mechanics and elasticity theory. The present paper compares the mechanical implications of this method with those of the viscosity and heat distributions assumed by Chapman and Enskog and their followers. It is shown that, whereas these latter distributions fail to meet any of the requirements of the dynamics of collisions in the cases considered, the ellipsoidal and limacoidal distributions satisfy them all. They are, moreover, in accord with many of Maxwell's writings on this subject. R. W. P.

CONVECTION.

3930. Natural Convection from Parallel Vertical Heated Plates in Air. L. G. Carpenter and H. C. Wassell. *Inst. Mech. Eng., Proc.* 128. *pp.* 439–457, 1934.—The paper describes experimental work on the convective heat loss as a function of the spacing between the plates and of their height. Two plates of heights 48 and 16 in. respectively were used. The larger plate consisted of three separately heated horizontal panels, so that it was possible to determine how the loss varied up the height of the plate. The results are given in the form of tables and curves, which cannot be briefly abstracted. L. G. C.

3931. Forced Convection. W. G. Bickley. *Phil. Mag.* 20. *pp.* 322–343, *Aug.*, 1935.—Mathematically exact solutions of problems of forced convection have not previously been given for even the simplified case in which the fluid is assumed to be inviscid and incompressible, its motion irrotational, and its physical properties independent of temperature. Such exact solutions are now obtained for some simple distributions of temperature and heat emission. The heat loss from the surface of a semi-infinite plane maintained at a uniform temperature, and subjected to a wind stream parallel to its surface and perpendicular to the leading edge is found to be proportional to the square root of both the wind velocity and the length of surface considered. This agrees with the result obtained by Boussinesq, and confirms the validity of his approximate mathematical solution. The accurate solution for an obstacle of finite cross-section is not yet found, but the use of elliptic coordinates is indicated. [See following Abstract.] R. W. P.

3932. Short Table of the Functions $\mathrm{Ki}_n(x)$. W. G. Bickley and J. Nayler. *Phil. Mag.* 20. *pp.* 343–347, *Aug.*, 1935.—Numerical values of the function $\int_0^\infty (e^{-x\cosh u}/\cosh^n u)\,du$, denoted by $\mathrm{Ki}_n(x)$, which are required in solving convection problems [see preceding Abstract] are given to nine places of decimals for values of x ranging from 0·0 to 3·0, and for values of n ranging from 1 to 16; the method of derivation being indicated. R. W. P.

MELTING AND BOILING POINTS.

3933. Physical Properties of Cyanogen and Its Halides. R. P. Cook and P. L. Robinson. *Chem. Soc., J. pp.* 1001–1005, *July*, 1935. The apparatus and methods used for the preparation, purification and determination of many of the properties of CN and its halides are described. The determined data are compared with such published data as are available, and are summarised in the following table which also includes data for HCN.

Compound	$(CN)_2$	CNCl.	CNBr.	CNI.	CNH.
B. p	−21·17°	+12·6°	+61·3°	—	+25·70°
$\lambda_{b.p.}$*	5778	6358	—	—	6760
M. p	−27·9°	− 6·5°	+51·3°	+146°	−14·0°
D of liquid at b. p.	0·9537	1·1963	1·8633	(*ca.* 2·59)	0·6820
Coeff. of expansion × 10^5	209·6	168·5	145·2	—	288·0
Mol. vol. at b. p.	54·55	51·38	56·85	(*ca.* 58·8)	39·50
Mol. diameter × 10^9	9·809	8·882	9·186	(*ca.* 9·29)	9·656
$d\gamma/dt$ (obs.)	0·213	0·150	0·176	—	0·133
Ramsay-Shields const., *K* †	2·18	—	—	—	1·10
Trouton's constant	22·94	22·26	—	—	22·49
Chemical constant, *i* ‡	2·947	2·988	3·030	—	3·000
$\gamma_{b.p.}$	21·98	2·390	25·84	—	17·10
$\gamma_{b.p.}$ (Walden) §	23·85	29·36	31·91	—	40·27
Mean mol. parachor (obs.)	117·7	113·6	128·4	—	81·5
,, ,, ,, (calc.)	125·0	116·3	130·5	—	79·6
Parachor of CN (obs.)	58·9	59·8	60·4	—	64·4
,, ,, (calc.)=62·5					

* $\lambda_{b.p.}$= Molecular heat of vaporisation at the b. p. † $K=d[\gamma(M/D)^{2/3}]/dt$.
‡ $i=1\cdot33 \log T_{b.p.} - 0\cdot00098\, T_{b.p.}$ § $\gamma_{b.p.}$ (Walden) $= T_{b.p.}\, 2\cdot15 \log T_{b.p.}/M V_{b.p.}$

The absence of association of CN as compared with the chloride and bromide is confirmed. The observed parachor of CN in the several compounds, though below the calculated value, based on data supplied privately by Sugden, are in accordance with a triple bond. Both the chloride and bromide are apparently slightly associated. P. H. B.

3934. Continuity of the Solid and the Liquid States. J. Frenkel. *Nature*, 136. *pp.* 167–168, *Aug.* 3, 1935.—The author contends that the solid, liquid and gaseous states of aggregation must be regarded as forming one continuous sequence, the sharp transition points, melting or boiling, being simply substitutes for transitions through unstable intermediate states. Evidence in support of this view is briefly discussed. J. S. G. T.

***3935. Cryogenic Laboratory of the California Institute of Technology. Part I. A. Goetz.** *Rev. Sci. Instruments*, 6. *pp.* 217–229, *Aug.*, 1935.—Of a description of the cryogenic laboratory this paper is the first part containing the general layout, the details of the equipment for the liquefaction of hydrogen including a method of purifying hydrogen and a description of the Simon liquefier and the vacuum system. The capacity of the hydrogen unit is 4·5 ± 0·5 l. per hour; 1·3 ± 0·1 l. of liquid air are needed per l. of liquid hydrogen. The plant can be run permanently by one man. AUTHOR.

TEMPERATURE, MEASUREMENT OF.

3936. Production of Temperatures Below 1° K. by Adiabatic Demagnetisation of Gadolinium Sulphate. W. F. Giauque and D. P. MacDougall. *Am. Chem., Soc., J.* 57. *pp.* 1175–1185, *July*, 1935. —To produce low temperatures below 1° K. by adiabatic demagnetisation $Gd_2(SO_4)_3.8(H_2O)$. was used. An inductance coil surrounding the sample, but thermally insulated from it by a vacuum, is used to measure the differential magnetic susceptibility. Magnetic susceptibility variation with field-strength gives no indication of ferromagnetism in this substance, whilst the results obtained with alternating fields of 60 and 1000∼ are in agreement, thus signifying the reversible character of the magnetisation. In a 60-cycle field with a maximum of 52 kilogauss applied, the maximum energy temporarily withdrawn from the field at each alternation had less than 0·01 % of the loss due to magnetic hysteresis or eddy currents. The lowest temperature attained was 0·242° K. A starting temperature of 1·29° K. and 8000 gauss were used and the lower temperature is based on the assumption of Curie's law. Inductance bridge measurements with a precision of 0·0003° were used to confirm these values. Tables are presented showing the change of temperature, differential susceptibility energy and heat content accompanying adiabatic magnetisation from a number of temperatures below 1° K. The effect of the interaction of Gd atoms gives rise to energy levels whose separation is comparable to kT at temperatures below 1° K., and tend to make the magnetic system approach zero entropy as called for by the third law of thermodynamics. The considerable heat capacity in this region has been determined to 0·3° K. S. G. B.

3937. Surface Temperature of Sliding Metals. F. P. Bowden and K. E. W. Ridler. *Cambridge Phil. Soc., Proc.* 31. *pp.* 431–432, *July*, 1935.—The surface temperature developed between two metals in sliding contact is measured by using the metals as a thermocouple. The e.m.f., electrical resistance and the coefficient of friction between polished surfaces are determined simultaneously, and it is shown conclusively that the maximum temperature developed is the melting point of the fusible metal. H. J. H. S.

THERMOCHEMISTRY.

See Abstracts 3778, 3891.

THERMODYNAMICS.

3938. Critical Constants of Gaseous Fluorides. H. S. Booth and C. F. Swinehart. *Am. Chem. Soc., J.* 57. *pp.* 1337–1342, *July*, 1935.—The critical constants of seven fluoride gases were determined. The equilibrium method used allowed the temperature to be ascertained in five cases to 0·02° and the pressure to less than 0·05 atmosphere. The critical opalescence was shown to be a dispersion of two phases and not stable above the critical temperature. Van Laar's addition of van der Waals constants was applied to the silicon compounds. A numerical relationship between the critical temperatures of the fluorochlorosilanes and silicon tetrafluoride, which suggests that the value of the critical temperature of silicon tetrachloride in the literature is too low, has been demonstrated. AUTHORS.

3939. Properties of Real Gases Based on the Thermodynamic Equation of State. Part VIII. Inversion Line of the Joule-Thomson-Effect for Helium. W. Jacyna. *Zeits. f. Physik.* 95. 9–10. *pp.* 692–697, *July* 1, 1935.—Based on the simplified equation of state [see Abstract 3569 (1935)], $e^{-\eta} + (1 - \psi/11\psi_0)\,\psi\,(\partial\eta/\partial t)_p - 1 = 0$, it is found that in connection with the calculated μ_J-inversion-line (1) no transition points (to the first order) of the Joule-Thomson-effect for helium can occur above about 50 atmospheres pressure; (2) the J-T-effect is either negative or zero in the intrinsic gaseous state; (3) the positive J-T-effect is a singularity of the gaseous state, which can only take place in consequence of actually attainable moderate temperature limits. The results are assembled in tabular form and are graphically compared with the classical Amagat-Berthelot theory. H. H. Ho.

3940. Equation of State of Monolayers. J. S. Mitchell. *Faraday Soc., Trans.* 31. *pp.* 980–986, *Aug.*, 1935.—The equation of state of an imperfect gas film is obtained and a method of correlating the surface potential with the deviation from the perfect gas laws is tentatively suggested. It is shown that exact comparison of theory and experiment is at present impossible owing to lack of measurements giving the temperature variation both of the departures from the perfect gas laws and of the surface potentials. A method of collecting data analogous to the Leiden method for gases is suggested. AUTHOR.

3941. Rapid Expansion in a Gas. P. Noaillon. *Comptes Rendus*, 201. *pp.* 258–260, *July* 22, 1935.—The phenomenon of propagation of a rapid compression in a gas is well known from the work of Riemann, Hugoniot and Hadamard. It has been shown that this phenomenon is always accompanied by a rapid increase of entropy. The laws of the phenomena associated with a rapid expansion in a gas are investigated. For the three-dimensional problem the method of characteristics due to Goursat is used. It is found that for a sufficient rapidity the perfect gas only expands into a part of the space available. By making use of the method due to Picard (successive approximations and integral equations) the discussion may be extended to all cases. G. F. P. T.

3942. Heat Capacity of Methane and Halogen Derivatives from Spectroscopic Data. R. D. Vold. *Am. Chem. Soc., J.* 57. *pp.* 1192–1195, *July,* 1935.—The molal heat capacity over the temperature range 0 to 500° has been calculated for methane, methyl chloride, methylene chloride, chloroform and carbon tetrachloride from spectroscopic data. It has been shown that the values obtained are probably good to 3 % and are far more reliable than the fragmentary experimental thermal data. AUTHOR.

3943. Second Virial Coefficient and Specific Heats of Oxygen. J. A. van Lammeren. *K. Onnes Lab. Leiden, Comm. Suppt. No.* 77*b. Physica,* 2. *pp.* 833–839, *Aug.,* 1935. *In English.*—The calculations on the second virial coefficient previously made by Keesom, van Itterbeek and van Lammeren [see Abstract 524 (1932)] on the basis of their measurements of the velocity of sound have been repeated, applying more data at liquid ethylene temperatures in order to obtain a better fitting to the *S*-curve in this region. The calculations are repeated with some alterations. New values of the second virial coefficient and the specific heats at liquid oxygen temperatures are given.

3944. Perfect Ternary Solid Solutions. H. Seltz. *J. Chem. Phys.* 3. *pp.* 503–505, *Aug.,* 1935.—Equations are developed for calculating the solidus and liquidus surfaces, with tie-lines, for ternary systems showing complete solid solubility, based on the assumption that both liquid and solid solutions are perfect. The forms of the liquidus and solidus isotherms predicted by these equations are considered for a hypothetical example. The ternary system of Au, Cu and Ni is shown to deviate markedly from ideal behaviour at low mol fractions of Au, even though the Cu-Ni system is practically ideal in its binary behaviour. [See Abstract 2111 (1934).] AUTHOR.

3945. Calculation of Entropies from X-Ray Data. Foo-Song Lei and H. S. Frank. *Chinese Chem. Soc., J.* 3. *pp.* 199–205, *July,* 1935. *In English.*—Calculations are reported showing that for ordinary temperature (25° C.) or above, and ordinary molecular weights and dimensions (benzene) the customary formula for the rotational "sum of state" $Q_r = 16 \sqrt{2}\, \pi^{7/2} (kT)^{3/2} \sqrt{ABC}/h^3$ gives results in excellent agreement with the exact expression $Q_r = \Sigma_r P_r e - E_r/kT$. AUTHORS.

3946. Transition and Thermodynamic Values of Silver Sulphide. G. Kimura. *Tôhoku Univ., Sci. and Technol. Reports,* 24. *pp.* 77–90, *May,* 1935. *In English.*—By using Smith's differential gas dilatometer the transition between rhombic and cubic forms of silver sulphide has been studied and transition point found at 175°—176°. The volume change due to this transition is $\Delta V = 0{\cdot}00065$ cc./gm. The values of ΔF°_{298} and ΔH°_{298} of the formation of Ag_2S were calculated from the results of the e.m.f. measurement of the reversible cell, $H_{2p\text{atm}.} \mid HCl_{m\text{norm}.} \mid HCl_{m\text{norm}.} H_2S_{p\text{atm}.} Ag_2S \mid Ag.$ $2Ag + S_{(\text{rhomb})} = Ag_2S$; $\Delta F^\circ_{298} = -9542$ cal.; $\Delta H^\circ_{298} = -7603$ cal. AUTHOR.

3947. Entropy and the Absolute Rate of Chemical Reactions. Part II. Unimolecular Reactions. O. K. Rice and H. Gershinowitz. *J. Chem. Phys.* 3. *pp.* 479–489, *Aug.,* 1935.—Eyring's theory [see Abstract 1206 (1935)] has been applied to a discussion of various unimolecular reactions. A number of cases have been treated by considering the reverse bimolecular or trimolecular association and discussing the extent to which rotational degrees of freedom must be frozen out in order for the associations to occur. Other cases have been treated by the activated complex method, which involves discussion of the number of free rotations and the frequency of the vibrations in the complex. It has been shown that it is possible to account for the rates of a considerable number of unimolecular reactions by making reasonable assumptions and that there is a considerable class of unimolecular reactions which conform to what is designated as the " hypothesis of exact orientation." [For Part I see Abstract 802 (1935).] AUTHORS.

3948. Thermodynamics and Affine Geometry. L. Brillouin. *J. de Physique et le Radium*, 6. *pp*. 359–360, *Aug*., 1935.—The thermodynamic variables, *p*, *v*, T, have their respective units, but these units are not comparable one with another. Thermodynamic diagrams are therefore best discussed in terms of affine geometry. The nature and significance of this geometry are very briefly discussed. J. S. G. T.

See also Abstracts 3780, 3811, 3936, 3964, 3993, 3997.

VAPOUR PRESSURE.

3949. Vapour Tensions of Solid Oxygen and Nitrogen. S. Aoyama and E. Kanda. *Tôhoku. Univ., Sci. and Technol. Reports*, 24. *pp*. 107–115, *May*, 1935. *In English*.—The vapour tensions of solid nitrogen and oxygen have been measured by the use of a liquid hydrogen cryostat. The corrections due to enormous temperature differences between the manometer and the cryostat are made. The theoretical vapour tensions have been calculated and compared with those observed. AUTHORS.

3950. Vapour Pressure of Aqueous KCl Solution and its Thermodynamic Significance. Z. Shibata and K. Niwa. *Zeits. f. phys. Chem*. 173. *Abt.A*. 6. *pp*. 415–426, 1935.—The vapour pressure and the lowering of vapour pressure of solutions of KCl were measured by means of a Rayleigh differential manometer between 0° and 10° C. and with concentrations from $0 \cdot 2786\ M$ to saturation. The following relationship was found between the saturation concentration and the total heat of solution of the saturated solution, which was valid up to 25° C. : $m.L_s = -\ 17{,}811$ calories. The following thermodynamical quantities were calculated from the experimental results : (*a*) The activity of the water in each solution and the relationship between activity and temperature. The reciprocal of the temperature and the activity are linearly related. (*b*) The heat of dilution of each solution for each temperature. (*c*) The final heat of solution at each temperature. (*d*) The coefficient of activity of KCl at 25° C. in aqueous solution. The relationship between the coefficient and the concentration (*m*) shows a minimum value between $2M$ and $2 \cdot 5\ M$. S. G. B.

See also Abstracts 3780, 3938.

ACOUSTICS.

3951. Diffraction of Sound Waves by Spherical and Cylindrical Obstacles. K. Nakabayasi. *Tôhoku Univ., Sci. and Technol. Reports,* 24. 1. *pp.* 1–13, *May,* 1935. *In English.*—The diffraction of sound waves by a fixed sphere and cylinder, when the incident wave is a semi-infinite or a finite wave-train, are treated. The effect of the head of the wave-train and the force acting on the sphere are especially investigated. The case of a cylinder is more complicated than that of the sphere. AUTHOR.

3952. Theory of Rayleigh Disc. A. B. Wood. *Phys. Soc., Proc.* 47. *pp.* 779–793, *Sept.* 1, 1935.—König's theory of the Rayleigh disc assumes the disc to be motionless, apart from its slow rotation. This assumption is unjustifiable in a relatively heavy medium such as water. The disc partakes of the motion of the medium to an extent depending on the density of the medium and the mass and dimensions of the disc. Consequently the fluid velocity v in König's equation for the torque on the disc must be modified by the introduction of a factor β involving the velocity of the disc relative to the medium. The value of β for ellipsoidal discs is calculated from hydrodynamic theory and determined experimentally. A comparison is made of the results for ellipsoidal discs and for flat cylindrical discs. A method of measuring sound-intensities under water by means of small heavy metal discs is described. AUTHOR.

3953. Experimental Determination of Frequencies of Free Circular Plates. A. B. Wood. *Phys. Soc., Proc.* 47. *pp.* 794–799, *Sept.* 1, 1935.—The paper deals with an experimental determination of the frequency of vibration of circular plates of appreciable thickness. Two sets of observations made (i) with steel discs varying in diameter from 6 to 16 cm. and in thickness from 0·07 to 2·8 cm., and (ii) with discs of various materials all 2 cm. in dia. but varying in thickness, are described. Frequencies were measured at which the discs vibrated with (*a*) two nodal diameters (*b*) one nodal circle. The experimental results are compared with theoretical values. The method may be applied to determine the velocity of sound in materials available only in small quantities. AUTHOR.

3954. Observation of Sound Waves in Gases. O. Brandt and H. Freund. *Zeits. f. Physik,* 95. 5–6. *pp.* 415–416, *June* 17, 1935.—A development of Dvorak's method (*Pogg. Ann.* 153, 102, 1874) is described for exhibiting stationary waves in a tube by using a thin layer of liquid on the walls. By illuminating the tube from above a series of sharp bright lines is obtained which mark the positions of the antinodes. Besides facilitating accurate measurement the method is also valuable for demonstration purposes. It is particularly applicable to h.f. sound. J. E. R. C.

3955. Pipes and Resonators. L. Marty. *Rev. d'Acoustique,* 4. *pp.* 13–52, *Jan.–March,* 1935.—A discursive account, with particular reference to orifices, of phenomena associated with pipes and resonators. The three main topics considered are (1) the characteristic frequency of a resonator, the frequency corresponding to " strongest resonance," and the frequency of the note obtained when source and resonator are coupled ; (2) the possibility of dividing certain cavities into independent elements without alteration of the frequency of the notes to which they resound ; (3) the theory of resonators, in which particular regard is paid to the subject of acoustic resistance, and the results of experimental work are reported. In this section, which constitutes a reasoned critique of the subject, the divergences between the postulates of theory and the actualities of practice are emphasised and general equations are replaced by formulæ appropriate to special cases. [See also Abstract 3830 (1934).] E. J. I.

3956. Demonstration of Diffraction with Ripples and Supersonic Waves. E. Grossmann and E. Hiedemann. *Zeits. f. Physik,* 95. 5-6. *pp.* 383–390, *June* 17, 1935.—Experiments are described, using both water ripples and ultrasonic waves, in which diffraction has been studied. The form of the wave-fronts both in sound radiated from a piston and also in sound which has passed through a slit has been investigated and typical photographs are reproduced. By using lycopodium dust the curves of equal amplitude have also been obtained. J. E. R. C.

3957. Influence of Noise and Tremors on Health. I. Katel. *Rev. d'Acoustique,* 4. *pp.* 86–96, *May,* 1935.—The author measures the intensity of tremors in terms of a unit (the " Pal ") defined in a similar manner to the decibel, and suggests a scale (comparable with a " noise thermometer ") of five degrees of sensation. The experiments of Reiher and Meister, in which patients were subject to tremors of known (low) frequency (N) and amplitude (A), are outlined, and from their results it is inferred that the least troublesome disturbances are those in the direction of the axis of the body. The lines of demarcation between the different degrees of sensation are given roughly by $AN^k = c$, where k and c have values peculiar to the limit concerned. Near the threshold of sensation $k=1$, *i.e.*, velocity is the controlling factor ; while near the upper limits k approaches 2, indicating that the curve separating two degrees of sensation is one of constant acceleration. The paper contains references to work of a similar nature published in several journals. E. J. I.

***3958. Stroboscopic Demonstration of Ripple Phenomena. E. Tyler.** *School Science Rev.* 63. *pp.* 347–355, *March,* 1935.—A stroboscopic method suitable for viewing the formation of ripples on either a mercury or water surface is described. The principle of the method consists in illuminating the ripple surface with intermittent light supplied by a flashing Osglim, mains-operated at 50 cycles/sec. Simultaneous operation of a loud-speaker unit functioning as the vibrator producing the ripples, also by the same a.c. supply, provides automatic synchronisation between the ripple disturbances and the intermittent illumination, thus effecting correct stroboscopic conditions for viewing. Typical photographs are included illustrating the possibilities of the method. AUTHOR.

3959. Definitions of Acoustic Quantities. L. Bouthillon. *Rev. d'Acoustique,* 4. *pp.* 57–85, *May,* 1935.—A discussion of definitions and terms employed in acoustics under the main headings of (1) intervals and levels, (2) expressions concerned with oscillations, (3) terms derived from electrical technology, and (4) definitions of purely acoustic quantities. [see Abstract 4279 (1934).] E. J. I.

See also Abstracts 3734, 3810, 3840. 3943.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

3960. Theory of Discharge in Gases. A. Rostagni. *Accad. Sci. Torino, Atti,* 70. 4. *pp.* 576–580, 1934–1935.—By examination of experimental results, the conclusion is drawn that the initiation and maintenance of discharge in gases is due principally, if not exclusively, to the liberation of electrons from the kathode by positive ions. H. M. B.

3961. Structure of the Electric Arc. N. Szulc. *Comptes Rendus,* 201. *pp.* 48–50, *July* 1, 1935.—The structure of the electric arc is studied by observing the radiation from the interior of the arc through one of the carbon electrodes which is perforated. The anode contains the salt which activates the arc. A photograph of the spectra emitted by the arc in $BaCl_2$ vapour and in a mixture of 50 % $BaCl_2$ and 50 % $CaCl_2$ is given. In the central part of the arc the molecules of the salt are dissociated and in the outer regions compounds are formed from the dissociated elements. The arc consists of two portions, a conducting portion in which the electrical energy is dispersed in the dissociation of exothermic compounds and the formation of endothermic compounds and a less powerfully conducting portion in which exothermic compounds are formed. W. R. A.

3962. Investigation of Corona Discharges by Means of a Cloud Chamber. H. Kroemer. *Zeits. f. Physik,* 95. 9–10. *pp.* 647–651, *July* 1, 1935.—In a previous paper [see Abstract 415 (1935)] it was shown that in the investigation of electric discharges use could be made of a Wilson cloud chamber to render visible discharge paths of the canal type. Similar observations show that corona discharges are built up from canal-type discharges produced in about 10^{-6} sec. The phenomena vary with the polarity of the electrodes. Evidence is given of the existence of space charges in the canal discharges. A. W.

3963. Excitation Efficiency of Slow Electron Collisions with Inert Gas Atoms. H. Maier-Leibnitz. *Zeits. f. Physik,* 95. 7–8. *pp.* 499–523, *June* 26, 1935.—The excitation of He, Ne and A by electron collision is investigated by an electrical multiple collision method. Two methods are given for measuring with a good degree of accuracy the total efficiency of a collision, at low electron velocities, *i.e.*, the excitation probability of the totality of terms. Efficiencies of a few per cent. are found. Some information is given about the excitation functions of individual terms. In several cases the efficiencies are found to exhibit very sharp maxima within 1 volt above the excitation potential. J. E. K.

3964. Calculation of Ionisation Potentials from the Thomas-Fermi Equation with Dirac's Exchange Correction. L. Hulthén. *Zeits f. Physik,* 95. 11–12. *pp.* 789–795, *July* 12, 1935.—The significance of the parameter dE/dN (E = energy ; N = number of electrons) in the Thomas-Fermi equation is indicated and the analogy with the Gibbs chemical potential is briefly discussed. Expressions of the form $-\frac{1}{e}\int_{N-1}^{N}\frac{dE}{dN}\,dN$, are derived for the ionisation potentials, and the evaluation of this integral is accomplished by means of a numerical solution by H. Jensen which is not yet published. H. H. Ho.

3965. Theories of Ionisation. J. S. E. Townsend. *Phil. Mag.* 20. *pp.* 242–263, *Aug.*, 1935.—The experimental results of different workers on ionisation in gases and related phenomena are examined and found to be in good agreement with theories of long standing proposed by the author. It is claimed that in many cases, application of Franck and Hertz's theory of collisions of the second kind leads to definitely wrong results. It is concluded that the general Townsend theory in which single collisions produce atomic excitation and ionisation is adequate to explain all known phenomena in the ionisation of gases, and many experiments of the Oxford school, using both pure and impure gases, are quoted in support of the contention. F. C. C.

3966. Ionic Recombination in Gases. W. R. Harper. *Cambridge Phil. Soc., Proc.* 31. *pp.* 429–430, *July*, 1935.—A correction [see Abstracts 3413 (1932) and 1590 (1933).]

***3967. Production of High Potentials by Use of a Unipolar Charged Air Current. E. Burkhardt.** *Ann. d. Physik*, 23. 4. *pp.* 339–370, *July*, 1935.—The different methods available for the production of ions are reviewed. In the method used, a jet of water is forced by compressed air through an atomiser in the presence of a strong electric field. A charge density of 12 e.s.u. per c.c. was produced per sec. in a volume of 5 × 10^4 c.c.; an insulated electrode supported in the jet acquired a potential of 420 kV. The stream of ions produces an intense glow in the air up to a distance of 60 cm. from the jet. The change in electrical mobility of the droplets due to evaporation and agglomeration was investigated together with the variation in electric field-strength and the pressure distribution in the ion stream. The effect of the back electric field was examined and the efficiency of the apparatus was found to be about 1 %. A potential of 420 kV was reached, the value being limited by the electrical properties of air, which was the surrounding medium. By the use of two jets, two streams of ions of opposite sign may be obtained and a potential of double the previous value may be produced. F. C. C.

3968. Absorption and Diffusion of Positive Rays in Gases. A. Rostagni. *Accad. Sci. Torino, Atti*, 70. 3. *pp.* 472–486, 1934–1935.—The total efficacious sections were determined by the absorption of the ions A^+, Ne^+, He^+ in the respective gases, at velocities comprised between 900 V and 28 V, with diaphragms of various apertures. Deduction is made of the values of the efficacious sections by diffusion, fixing the signification of these. [See also Abstract 2594 (1934).] J. J. S.

***3969. Production and Focusing of Intense Positive Ion Beams. M. A. Tuve, O. Dahl and L. R. Hafstad.** *Phys. Rev.* 48. *pp.* 241–256, *Aug.* 1, 1935.—A high intensity source of positive ions utilising a gaseous l.v. arc constricted by a metal capillary has been developed. With 250 watts input and 10 c.c. gas flow per hour, this source delivers controllable positive ion currents up to 1·5 mA through a probe canal 1 mm. in diameter. The focusing of weak and intense positive ion beams by various electrostatic lens arrangements has been empirically investigated, giving additional data on quantitative design concerning the multiple section h.v. tubes long in use in the laboratory of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, and indicating the requirements met in delivering the total ion current from the source on to a target at the far end of such a tube. AUTHORS.

***3970. H.V. Technique for Nuclear Physics Studies. M. A. Tuve, L. R. Hafstad and O. Dahl.** *Phys. Rev.* 48. *pp.* 315–337, *Aug.*

15, 1935.—A 1-m. dia. electrostatic generator of the type designed by van de Graaff reaches usable steady potentials up to 600 kV (positive). A generator comprising concentric 1-m. and 2-m. shells, charging current 0·75 mA, reaches practical limitations at 1300 kV (positive) in a special room of large size. Voltages below the maximum are steady to within several percent. Details of design and operation are discussed. Multiple-section h.v. tubes of the Coolidge " cascade " type, giving complete focusing of positive ion currents of 20 mA at voltages up to 1200 kV, offer no difficulties in construction or operation. No reasons have yet appeared for expecting any special troubles if this technique were to be extended to much higher voltages and currents. AUTHORS.

***3971. Improved Counting Circuit. H. P. Barasch.** *Phys. Soc., Proc.* 47. *pp.* 824–834, *Sept.* 1, 1935.—This paper deals with a simple Geiger-Müller counter circuit, the essential feature of which is the application of a special characteristic curve of a pentode valve. This (i_a, e_g) curve has a saturation portion in the negative grid region. The output pulses from the circuit are equalised, free from secondary disturbances, and of shortened duration. By means of an appropriate resistance-capacity coupling to the thyratrons a back pulse is generated, so that the final pulse-shape is more suitable for triggering the thyratrons. A description of the simple pentode circuit is given and also of a universal set, consisting of four valves, which is suitable for coincidence counting. The special characteristic curve when applied to the coincidence circuit leads to improved discrimination between total and partial coincidences. AUTHOR.

See also Abstracts 3721, 3722, 3723, 3732, 3850, 3880, 3885, 3897, 3922, 4000.

CONDUCTION IN SOLIDS AND LIQUIDS.

3972. Anomalous Electric Resistance of Ferromagnetics. T. Hirone. *Tôhoku Univ., Sci. and Technol. Reports,* 24. *pp.* 122–127, *May,* 1935. *In English.*—The anomaly of the electric resistance of the ferromagnetic substance is explained by the fact that the mean free path of the conduction electron is affected by the rotational vibration of molecular magnets in the Honda-Ôkubo model of ferromagnetic substance. It is also to be noted that the equation of corresponding state exists between the reduced resistance and the reduced temperature of the ferromagnetic substance. This conjecture has been confirmed by the results of measurement upon Fe, Co and Ni. AUTHOR.

3973. Mean Free Path of Metal Electrons. M. Satô. *Tôhoku Univ., Sci. and Technol. Reports,* 24. *pp.* 14–25, *May,* 1935. *In German.*—Values of the mean velocity, impact number of electrons with atoms, and mean free path of metal electrons are derived by application of Fermi statistical theory. It is shown that the mean free path of the electrons decreases proportionally to the square of the absolute temperature in the case of a strongly degenerate condition of the electron gas. A formula for the electrical conductivity of metals is deduced, and Brownian motion is briefly discussed. J. S. G. T.

3974. Electronic Conduction and the Lattice Stability of Binary Crystals. T. Neugebauer. *Zeits. f. Physik,* 95. 11–12. *pp.* 717–733, *July* 12, 1935.—The potential energy of various forms of crystal lattice of binary compounds is derived by expanding in a series of spherical harmonics the expression for the potential due to the various ions in the neighbourhood of any particular ion. Electronic conduction is shown to increase with increasing polarisation in the various types, attaining a maximum value in the NiAs type and disappearing in the molecular lattices. Polarisation is shown to explain the phenomenon of the occurrence of Langmuir's isosterism in crystals of the zinc blende and wurtzite types, in which polarisation energy is large, and the absence of this phenomenon in the case of crystals of the NaCl type. J. S. G. T.

3975. Electrical Conductivity of Water. A. Kling and A. Lassieur. *Comptes Rendus*, 201. *pp.* 203–204, *July* 16, 1935.—The conductivity of H_2O is not a safe guide to the presence of minute amounts of CO_2; it appears to depend on the method of purification, being substantially higher in H_2O distilled in a Pt vessel than in a glass one. It is not a satisfactory method of determining *pH*. C. A. S.

3976. Electrical Conductivity of Strong Electrolytes in Dilute Solution. C. J. B. Clews. *Phys. Soc., Proc.* 47. *pp.* 818–823, *Sept.* 1, 1935.—The work described in a previous paper [see Abstract 5202 (1934)] has been extended to the measurement of the electrical conductivity of $0{\cdot}0005$-*N* solutions of KNO_3, K_2SO_4 and Na_2SO_4. These data, in conjunction with those previously obtained, provide strong evidence for the validity of the theory of Debye, Huckel and Onsager for uni-univalent electrolytes in dilute solutions up to 85° C. Agreement is not as satisfactory for Na_2SO_4, while an anomaly has been observed in the behaviour of K_2SO_4 solutions. AUTHOR.

See also Abstracts 3736, 3751, 3998, 4019, 4028.

DIELECTRICS AND CAPACITANCE.

3977. Inversion Phenomena in the Polarisation of Rochelle Salt. I. Kurtschatow and A. Schakirow. *Phys. Zeits. d. Sowjetunion*, 7. 5–6. *pp.* 631–638, 1935. *In German.*—The dependence of the velocity of the polarisation and depolarisation processes of Rochelle-salt crystals on various factors in the region of spontaneous orientation is investigated. It is found that under certain conditions the velocity of depolarisation is greater than that of the polarisation. The phenomenon is considered in connection with mechanical stresses in the crystal and with respect to Landau's theory of the kinetics of the spontaneous orientation process. A brief description of Landau's theory is given. A. M.-T.

3978. Dipole Moments of Vapours. Part II. L. G. Groves and S. Sugden. *Chem. Soc., J. pp.* 971–974, *July* 1, 1935.—Measurements of the dielectric constants of H_2O, D_2O, bromobenzene, ethyl benzoate, acetophenone, and *n*-valeronitrile have been made in the vapour state over a range of temperature and the dipole moments calculated. For all the substances there is a linear relationship between the polarisation and the reciprocal of the absolute temperature; extrapolation gives a value of $P_{A+E} \simeq$ optical polarisation. $\mathrm{P_A}$ is assumed to be 5 % $\mathrm{P_E}$, calculated from the refractive index for the Na-*D* line. The dipole moment of D_2O is indistinguishable from that of H_2O. The moments of the other substances are higher than those recorded for them from measurements in solution. For any homologous series *RX* where *R* is an alkyl radical and *X* a group possessing a considerable dipole moment then the dipole moments of the vapours are nearly constant except when *X* is H or CH_3, as for solutions. Sutton's generalisation [see Abstract 1314 (1932)] regarding the difference between the moments ArX and AlkX for aromatic and aliphatic compounds is confirmed although the differences are smaller in the vapour state. [For Part I see Abstract 3878 (1934).] W. R. A.

3979. Dielectric Constant of Hydrogen. A. Michels, P. Sanders and A. Schipper. *Physica,* 2. *pp.* 753–756, *Aug.,* 1935. *In English.*—The dielectric constant of H_2 has been measured at pressures up to 1425 atmospheres and at temperatures of 25° C. and 100° C. The Clausius Mossotti expression $P = (\epsilon - 1)/(\epsilon + 2)d$ is constant within the experimental accuracy. [See Abstracts 2565 (1933) and 3004 (1934).]
AUTHORS.

3980. Dielectric Properties of Vegetable Oils. G. R. Paranjpe and P. Y. Deshpande. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 880–886, *June,* 1935.—The density, refractive index and dielectric constants at room-temperature (26°) are determined for solutions of castor, olive, sesame and cocoanut oils in benzene. The dielectric constants were determined at 30 m. (10,000 kc.) by observing the resonance with the help of a valve voltmeter. It is found that in very dilute solutions the molecules of these oils are more or less free from association. Experiments on very dilute solutions of these oils therefore give fairly reasonable values for their electric moments which are in these cases $3{\cdot}68 \times 10^{-18}$, $3{\cdot}03 \times 10^{-18}$, $2{\cdot}91 \times 10^{-18}$ and $2{\cdot}82 \times 10^{-18}$ for castor, olive, sesame and cocoanut oils respectively.
AUTHORS.

3981. Dipole Moment of Deutero-Ammonia. J. M. A. de Bruyne and C. P. Smyth. *Am. Chem. Soc., J.* 57. *pp.* 1203–1205, *July,* 1935.—The triple point of ND_3 is found to have a temperature of $-73{\cdot}6°$ and a pressure of 48·6 mm. The dielectric constants of NH_3 and ND_3 have been measured at six temperatures within a range of 150° and used to calculate the dipole moments of the two molecules. The value found for NH_3, $1{\cdot}46_6 \times 10^{-18}$, agrees with the mean of the four accurate determinations in the literature, $1{\cdot}46 \times 10^{-18}$. ND_3 is found to have a moment $0{\cdot}03 \times 10^{-18}$ higher because of the lower energy of the zero level in the vibration of the three deutons with respect to the N nucleus, which causes the plane of these three nuclei to have a greater average distance from the N nucleus than is the case in NH_3.
AUTHORS.

3982. Dielectric Constants of Acetylenic Compounds. C. J. Wilson and H. H. Wenzke. *Am. Chem. Soc., J.* 57. *pp.* 1265–1267, *July,* 1935.—The presence of the triple bond has a pronounced effect on the moments of the COOH group in the propiolic acids and on the ionisation constants of these acids. The data indicate that the H of the COOH group is more positive in the acetylenic acids than such acids as acetic. Electric moments have been determined for propiolic, tetrolic, phenylpropiolic, *p*-chlorophenylpropiolic, *o*-chlorophenylpropiolic, *p*-nitro-phenylpropiolic, *o*-nitrophenylpropiolic, phenylacetic, benzoic, *p*-nitrobenzoic, *o*-hydroxybenzoic, *m*-hydroxybenzoic and *p*-hydroxybenzoic acids.
AUTHORS.

3983. Rotating Polar Groups in Organic Molecules. W. Altar. *J. Chem. Phys.* 3. *pp.* 460–473, *Aug.,* 1935.—The temperature dependence of the electric moment observed in the case of molecules with rotating polar groups permits a quantitative explanation in terms of intramolecular forces opposing free rotation of the groups. The following questions have been raised and treated: (1) The statistical weight to be associated with a configuration. (2) Approximation of the periodic potential function by its first and second Fourier component. (3) An application to 1,2-dichloroethane is given and a plausible potential of interaction between the two CH_2Cl groups is obtained. The result suggests the presence of repulsive forces between two bound Cl atoms at distances as large as

4·0 Å. (4) The related question of the thermal equilibrium ratio of the *cis* and *trans* isomers of dichloroethlyene is discussed. A new explanation of the observed value is proposed, which attributes about equal heat of formation to both isomeric forms. AUTHOR.

3984. Electric Moments of the Alkyl Monohalides. P. C. Mahanti. *Phil. Mag.* 20. *pp.* 274–287, *Aug.*, 1935.—The temperature sensitivity of the dielectric constants of the vapours of the methyl, ethyl, and propyl halides and of allyl chloride has been measured by means of a sensitive heterodyne beat apparatus, with a view to obtaining accurate values for their electric moments. The results obtained are in accordance with the induction hypothesis. AUTHOR.

3985. H.V. Breakdown of Dielectrics. S. Whitehead and W. Nethercot. *Phys. Soc., Proc.* 47. *pp.* 974–997, *Sept.* 1, 1935.—Provided a sufficiently wide range of external conditions can be applied, dielectrics exhibit both a thermal and non-thermal type of breakdown. The electric strength for thermal breakdown can be calculated from the stable electrical properties of the dielectric and a simplified theory is given which is shown to agree with experiment for a number of dielectrics for different conditions of temperature, time of application of stress, etc. A theory of ionisation coefficients is developed to explain conductivity phenomena with a.c. and d.c. and ionisation potentials are deduced. It is, however, shown that these phenomena do not appear to bear a direct relation to the possible types of non-thermal breakdown and that the ionisation potentials have not the same physical significance as the corresponding quantities in gases. Experimental results relating to the type of non-thermal breakdown which occurred in the present investigations are given. AUTHORS.

3986. Dielectric Losses in Anisotropic Liquids. W. Fréedericksz, G. Michajlov and D. Bèneszewicz. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 2. *pp.* 469–473, *June*, 1935. *In German.*—A resonance method is described for the purpose of testing Kast's observation of maximum dielectric loss, and Hermann's suggestion of streaming. The former was not confirmed, but support was forthcoming for the latter. F. I. G. R.

See also Abstract 3806.

ELECTROCHEMISTRY.

3987. Activity Coefficients from Concentration Cell Potentials. A. S. Brown and D. A. MacInnes. *Am. Chem. Soc., J.* 57. *pp.* 1356–1362, *July*, 1935.—Accurate values of the activity coefficients of the ions of NaCl in aqueous solution at 25° have been determined by a method involving transference numbers and the potentials of concentration cells with transference. The resulting activity coefficients have been found to follow the Debye-Huckel theory to high precision, up to 0·05 *N*, with a " distance of closest approach " of 4·45 Å. AUTHORS.

3988. Behaviour of Tungsten in Potassium Hydroxide. M. de K. Thompson and C. W. Rice, Jr. *Am. Electrochem. Soc., Trans.* 57. *pp.* 71–78; *Disc.*, 79, 1935.—In an excess of potassium hydroxide, tungsten dissolves with approximately 100 % current efficiency under all conditions of current density and concentration tried, even when the polarisation rises to 110 V. High polarisation occurs the more readily the higher the current density, the more dilute the solution, and the lower the temperature. With electrolysis at high polarisation, the anode always becomes burnished in appearance, and if continued after all hydroxide is converted to orthotungstate, the current efficiency gradually falls, O_2 is evolved, the electrolyte turns blue, and paratungstate precipitates. The graphs of electrode potentials for a given current density against concentration of electrolyte are of the same form as those for Mo, but are limited to low current densities by high polarisation. The hydrogen overvoltage is least in H_2SO_4; in potassium hydroxide it decreases with increasing concentration of the hydroxide. AUTHORS.

3989. Electrolytic Reduction of Acetophenone. S. Swann, Jr. and G. H. Nelson. *Am. Electrochem. Soc., Trans.* 57. *pp.* 201–206; *Disc.*, 206–207, 1935.—The electrolytic reduction of acetophenone in H_2SO_4 solution has been studied at kathodes of Cd, Sn, Pb, Hg, Al, Zn, Ni, Cu and Fe. The main products of the reduction are acetophenone pinacone, bis (α-methyl)-benzyl ether, and a resin of unknown constitution. The best yield of acetophenone pinacone was obtained at the Pb kathode. AUTHORS.

3990. Nitration and Oxidation of Toluene. R. C. Kirk and W. E. Bradt. *Am. Electrochem. Soc., Trans.* 57. *pp.* 209–221, 1935.—A direct current was passed through mixtures of toluene with varying concentrations of HNO_3 and H_2SO_4. Acid concentrations were selected giving less than 100 % mono-nitration without the use of a current. This permitted the observance of either a positive or negative effect due to the current. Conditions affecting the oxidation and nitration of toluene were studied. Particular attention was given to the action brought about by the use of current. Conditions investigated were temperature, composition of nitrating mixture, current density, time, agitation, and addition agents. A maximum nitration increase, due to the current, of 11·9 % of the theoretical yield was obtained. The effect of conditions on the formation of carboxylic acids was also observed. AUTHOR.

3991. Oxido-Reduction at Kaolin Barrier in Cupric Solution During Electrolysis. Lina Guastalla. *Comptes Rendus*, 201. *pp.* 268–270, *July* 22, 1935.—With a similar arrangement [see Abstract 3014 (1934)] save that the pig's bladder is replaced by kaolin, the velocity with which the oxido-reduction process becomes apparent is independent of the thickness of the kaolin wall, and (with the same anion) increases as the electrolyte is less acid and more concentrated. C. A. S.

3992. Dissociation Constants of Acids in Light and Heavy Water. O. Halpern. *J. Chem. Phys.* 3. *pp.* 456–457, *Aug.*, 1935.—The ratio of dissociation constants of acids in light and heavy water is shown to become the larger the weaker the acid. This is a consequence of the differences in zero-point energy of the proton (deuton) when attached to the anion or the neutral water molecule. AUTHOR.

3993. Product-Current-Work Relationships in the Ideal Electrochemical Polyphase-System. E. Lange and K. Nagel. *Zeits. f. Elektrochem.* 41. *pp.* 575–582, *Aug.*, 1935.—This paper deals with Faraday's law of electrolysis in the ideal galvanic circuit. It is shown that the change of thermodynamic potential ΔG resulting upon material change may be reversibly converted into external work ΔA, if macroscopic chemical force vectors and suitable opposing forces are present. The practical execution is less easy for reactions in electro-neutral phase systems than for ionic reactions in electrochemical systems. The relationships in the ideal electrochemical 2-, 3-, and 4-phase systems are respectively considered in detail. The galvanic potentials of the separate phase junctions comprising the total e.m.f. depend only on the transport tendency of the potential determining ions and are not bound up with the place of the individual decompositions which is determined also by mobility, *e.g.*, the galvanic potential between the junction of two metals (*e.g.*, Zn and Cu) has not to be neglected even though no material changes take place. The application of the fundamental ideas now developed to more complicated systems such as multiple electrodes, real cells, etc., is indicated.

H. H. Ho.

3994. Transference Numbers by the Moving Boundary Method. L. G. Longsworth. *Am. Chem. Soc., J.* 57. *pp.* 1185–1191, *July*, 1935. —Measurements of the transference numbers at 25° of aqueous solutions of KBr, KI, KNO_3, NH_4Cl, $NaC_2H_3O_2$, $CaCl_2$ and Na_2SO_4 by the moving boundary method have been made. The results, interpolated to round concentrations, are given in a table. This table also includes values for salts which have been previously reported and thus constitutes a summary of all of the recent determinations by the moving boundary method. AUTHOR.

3995. Simultaneous Kathodic and Anodic D.C. Polarisation of Electrodes. Part I. P. S. Tutundžić. *Zeits. f. Elektrochem.* 41. *pp.* 602–611, *Aug.*, 1935.—The influence of uninterrupted superposed d.c. of different direction, voltage and strength on the potential of Pt, Pd and Au kathodes in $2N$ H_2SO_4 at room-temperature has been investigated. The potentials of the kathodes and the decomposition voltages are greatly influenced by kathodic or anodic polarisation, the potential at which H_2 separates being displaced far towards the positive side, to reach the constant end value $+ 0{\cdot}927 \pm 0{\cdot}005$ V when the opposed polarisations become equal. Assuming that complete electrolytic depolarisation of the discharged H_2 by the equivalent amount of the discharged O_2 occurs at the kathode, the above potential corresponds with water-formation direct from the electrolytic $2H + O$ at the current density $0A/cm^2$ without any participation of the kathode material. T. H. P.

3996. Influence of Electrode Surface on Anodic Processes. O. J. Walker and J. Weiss. *Faraday Soc., Trans.* 31. *pp.* 1011–1017, *Aug.*, 1935.—The two types of anodic process, *viz.* (1) the evolution of O_2 (which involves the phenomenon of oxygen overvoltage) and (2) oxidation of various inorganic and organic ions and molecules, are discussed. The influence of the addition of metallic salts (*e.g.*, of Pb, Mn, Ag, Co) to the electrolyte to be oxidised is studied with reference to the work of Glasstone and Hickling. The conditions for the discharge of anions and the breaking up of molecules at the anode have been considered, and the electron transfer to the metal anode is discussed. AUTHORS.

3997. Theory of Galvanic Potentials. Part I. P. Gross and O. Halpern. *J. Chem. Phys.* 3. *pp.* 458–460, *Aug.*, 1935.—In this paper a thermodynamic study of the theory of galvanic electrode potentials is presented. It is shown that, starting from strictly equilibrium conditions, the series of normal electrode potentials can be expressed through other partly known thermodynamic quantities, one group of which refers to the solid phase only, independent of the solvent used, while the other is characterised by the type of solvent. AUTHORS.

3998. E.M.F. Measurements with Electrometer Valves. F. Müller and W. Dürichen. *Zeits. f. Elektrochem.* 41. *pp.* 559–563; *Disc.*, 563, *Aug.*, 1935. An account of the measurement of the e.m.f.s of electrochemical elements by means of circuits employing thermionic valves of the electrometer type. The means adopted for obtaining high sensitivity with the minimum flow of current are discussed; also the importance of the measurements in relation to corrosion problems, pH determinations, and potential measurements on non-conductors. L. H.

See also Abstracts **3717**, **3897**.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

3999. Theory of Protons and Neutrons. G. Wataghin. *Accad. Lincei, Atti,* 21. *pp.* 703–708, *May* 19, 1935.—An equation similar to Dirac's electron equation is introduced to define the properties of the proton and the neutron, which are treated as different quantum states of one particle. The function is given 8 components and the matrices corresponding to the Dirac matrices have 8 rows and columns. In introducing the electromagnetic field a term is added depending on the first space derivatives of the potentials and this corresponds to treating the neutron as a magnetic and electric dipole. For the magnetic moment of the proton a value is derived which is in satisfactory agreement with Stern's measurements. States of negative energy appear as for Dirac and the theory yields negative protons and anti-neutrons which may be concerned in nuclear structure. W. S. S.

4000. Mass Variability of Electrons in Rapid Kathode Rays. M. Nacken. *Ann. d. Physik,* 23. 4. *pp.* 313–329, *July,* 1935.—The mass variability of electrons is measured by the method of electrical and magnetic deflection of kathode rays combined with the application of a relativity process. Full experimental details [see also Abstract 5227 (1934)] are given, together with tables of results, and a discussion of errors of measurement. Photographs and valid data are obtained up to 200 kV, and are only explicable by the Lorentz and not by the Abraham theory of mass variability. H. H. Ho.

4001. Born-Schrödinger Electron Radius. J. Meixner. *Ann. d. Physik,* 23. 4. *pp.* 371–379, *July,* 1935.—According to Born and Schrödinger the value of the Born electronic potential [see Abstract 1875 (1934)] is associated with an electronic radius equal to about $13 \cdot 6\ e^2/mc^2$. The effects of this radius upon the fine structure of the H and He^+ spectra are investigated, and it is shown that comparison between experimental results and theoretical deductions offers no objection to the postulation of such a large value of the electronic radius. J. S. G. T.

4002. Scattering of Fast Electrons from Thin Films. H. Saegusa and K. Kikuchi. *Tôhoku Univ., Sci. and Technol. Reports,* 24. *pp.* 30–44, *May,* 1935. *In English.*—The scattering of thermo-ions emitted from a tungsten filament, accelerated by electric potentials of 1×10^4 to $2 \cdot 8 \times 10^4$ V, and bombarding thin celluloid films of thickness 1000 Å and 200 Å is investigated. Within the scattering range of 30° to 50° the experimental distribution results confirm those of Klemperer [see Abstract 757 (1933)] and agree with results deduced from Möller's quantum-mechanical theory. The percentage scattered at 90° is less than that observed by Klemperer. J. S. G. T.

4003. Theory of Electron Scattering by Atoms. M. Ghosh. *Phil. Mag.* 20. *pp.* 234–242, *Aug.,* 1935.—It is claimed that in the derivation of the formulæ for electron scattering by atoms previous workers have failed to take into account the excluded phase space of the scattered electron. A wave statistical computation is made on the assumption that the incident electron has a lower limit r_0 to its distance of approach to the centre of the scattering atom. With Coulombian field and $r_0 = 0$, the result approximates to that already obtained by Mott for fast electrons; for moderate velocities the formula is identical with that calculated on classical theory multiplied by a factor $\cos^2 Dr_0$. Comparison with the experimental results of Hughes, McMillen and Webb [see Abstract 4558 (1932)] who used electrons of energies from 200 to 700 V incident on He, shows poor agreement if r_0 is equal to the closest distance of approach as calculated classically. To give better results semi-empirical values of r_0 are suggested. F. C. C.

See also Abstracts 3726, 3911.

ELECTROSTATICS.

4004. Electrostatic Potential of a Cuprite Crystal. T. S. Wheeler. *Indian Acad. Sci., Proc.* 1*A. pp.* 905–914, *June,* 1935.—A simple method [see Abstract 4473 (1932)] for the calculation of the potential of cubic crystal lattices, has been applied to the calculation of the electrostatic potential of cuprite. AUTHOR.

See also Abstract 3967.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4005. Thermomagnetic Hysteresis in Nickel Wire. Y. K. Hsü and W. Band. *Phys. Soc., Proc.* 47. *pp.* 910–922, *Sept.* 1, 1935.—The thermomagnetic e.m.f. in a nickel wire of dia. 1·0 mm. is produced by longitudinal magnetic fields and by longitudinal stretching in one-half of each of a set of various temperature-distributions. The hysteresis is examined as dependent both upon magnetism and upon tension. It is found that for zero tension the results agree with those of Broili to a first approximation, although there is still a measurable increase in e.m.f. not detected by Broili when the maximum temperature is raised above the Curie point. This is interpreted as due to the so-called Benedick e.m.f. depending on the temperature-gradient. The Curie-point increase is still greater in the results for stretched wire. The form of the hysteresis curve also becomes anomalous in that the e.m.f. reverses sign, relative to the original value, in two quadrants of the loop. The change in Thomson potential-gradient produced by various magnetising fields, at different tensions, is shown graphically as a function of temperature, to a first approximation obtained by neglecting the Benedick e.m.f. AUTHORS.

See also Abstract 3736.

MAGNETISM AND ELECTROMAGNETISM.

4006. Number of Electrons which Contribute to the Paramagnetism of Nickel. L. Néel. *Comptes Rendus,* 201. *pp.* 135–137, *July* 8, 1935.—The lowering of the Curie constant $(-\Delta c)$ in Ni alloys is proportional to the number of valency electrons (n) in the metal which is alloyed. Also the ratio $-\Delta c^{\circ} n \simeq 0\cdot512$ for all metals. It follows that (*a*) the atoms of the "foreign" metal replace atoms of Ni in the alloy, (*b*) the electrons of the "foreign" metal are disposed antiparallel to the magnetic electrons of Ni, (*c*) an electron of the "foreign" metal annuls the contribution of a magnetic electron of Ni. From this it can be calculated that 0·63 electron per atom in Ni contributes to the paramagnetic properties. This is substantially the same as for ferromagnetism (0·60) and it is concluded that in both types of magnetism the same electrons participate. W. R. A.

4007. Magnetic Properties of Cd Solutions in Molten $CdCl_2$ and of Molten Hg_2Cl_2. J. Farquharson and E. Heymann. *Faraday Soc., Trans.* 31. *pp.* 1004–1010, *Aug.*, 1935.—Magnetic measurements with solutions of cadmium in molten cadmium chloride and with molten calomel have been made. In no case has paramagnetism appeared. Thus a subchloride CdCl is definitely excluded. The probability of either a subchloride Cd_2Cl_2 or an atomic solution of cadmium in cadmium chloride is discussed as well as a more complex configuration. A comparison of the magnetic properties with the electric conductivity of molten calomel leads to the assumption that it consists of Hg_2Cl_2 molecules which are to some degree dissociated into Hg_2^{++} and chlorine ions; also in this case a more complex configuration is taken into consideration. There is an unexpected large rise in diamagnetic susceptibility when $CdCl_2$, $PbCl_2$ and Hg_2Cl_2 melt. AUTHORS.

4008. Magnetic Force at a Point on its Axis Due to a Current in a Helical Coil of One Turn. G. F. C. Searle. *Phys. Soc., Proc.* 47. *pp.* 900–903, *Sept.* 1, 1935.—The incomplete circuit formed by a single turn ABC of a helix of pitch p, which lies on a cylinder of radius a, is completed by a straight link CA, of length p, parallel to the axis of the cylinder. Through any point O on this axis are taken rectangular axes Ox, Oy, Oz. Of these, Ox is the axis of the cylinder, and Oz is parallel to the shortest distance between Ox and CA. The components H_1, H_2, H_3 of the magnetic force at O, due to a current in the circuit, are found for the case when p/a is small. AUTHOR.

See also Abstracts 3725, 3743, 3771, 3936, 3972, 4005.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4009. "Heat at a Point" in H.F. Fields. W. Krasny-Ergen. *Ann. d. Physik,* 23. 4. *pp.* 304–312, *July,* 1935.—It is an established fact in the use of electric waves for medicinal purposes that single cells in h.f. alternating fields appear to take up a higher temperature than those surrounding them. The cause of this is attributed either to difference in physiological response or effect of the short waves or to some other effect. The present paper discusses the probability of the cause of the phenomenon. By means of a mathematical argument the author deduces theoretical values and compares them with the experimental results of Kulka. It is shown that in practice the calculated values are never reached, but this is accounted for on the ground of cell dimensions, in relation to heat convection and radiation. S. G. B.

4010. Radioscopic Examination in a Light Room. Ledoux-Lebard, Long and Saget. *Comptes Rendus,* 200. *pp.* 2124–2126, *June* 17, 1935.—The radioscopy room is illuminated by light of a certain wavelength, and between the observer and the protective lead glass of the fluorescent screen is interposed a glass plate having definite transmission characteristics. General illumination is provided by a sodium vapour lamp, and the plate is of glass having a few per cent of neodynium oxide. This glass has high transmissions between 4000 and 5000 Å and 5360 and 6000 Å, and a strong absorption band between 5640 and 5900 Å, while the radiation from a fluorescent screen lies between 4500 and 4800 (for calcium tungstate) and 5200 and 5800 Å (for zinc sulphide). The glass screen is thus transparent for the light of the fluorescent image, but opaque to the sodium light. G. E. B.

4011. Hardness-Distribution of Scattered X-Rays Round a Phantom. L. Graf and R. Jaeger. *Phys. Zeits.* 36. *pp.* 483–486, *July* 15, 1935. *From the Reichsanstalt.*—Three qualities of primary X-rays were used, 100 kV without filter, 150 kV 0·5 cm. Cu filter and 190 kV 1 mm. Cu filter. The hardness-distribution (expressed in terms of half-value thicknesses of Cu) round a water phantom 20 cm.^{3} is shown in the form of a polar diagram. In the case of the two harder radiations, the scattered radiation is much softer than the direct. The scattered radiation is approximately of uniform hardness round the phantom, the lack of dependence on direction being attributed to multiple scattering and the use of a large phantom. In the case of the primary radiation at 100 kV without filter, the scattered radiation is harder than the direct in front of the phantom, the softening due to the Compton effect being over-compensated by the hardening of the scattered radiation by absorption in the phantom. These results and previous results are combined to show the dependence of the hardness of scattered radiation on the hardness of the primary, for half-value thicknesses up to about 5 mm. Cu. W. E. P.

*4012. **Comparison Photometer and its Use in Determining the Distribution of Radiation in a Phantom. M. M. D. Williams.** *Radiology,* 25. *pp.* 55–56, *July,* 1935.—In determining the intensity of X-rays in a rice phantom by the photographic method, a photometer has been devised, which is schematically illustrated, the chief feature of which is that the illuminating lamp is maintained at a constant illumination under control of two photoelectric cells. The use of this instrument in conjunction with photographic strip is briefly described. B. J. L.

4013. Effect of Hard X-Rays and γ-Rays of Radium. D. den Hoed. *Radiology,* 25. *pp.* 57–81, *July,* 1935.—The question as to whether with X-rays and γ-rays, the biological effect is dependent upon wave-length has been greatly discussed, and the literature is very extensive. In relation to this problem many investigators, who are mentioned in the present paper, have utilised varying methods of investigation, some holding such an effect exists and others holding contrary views. Most of these results have been obtained by employing X-rays below 200 kV excitation. The present investigator gives extensive graphical and numerical details of investigations with X-rays emitted at 100 kV, 200 kV, 360 kV and the γ-rays of radium, both radiations being via variations filtrations which are given. The methods of intensity measurement used were the mortality of drosophila eggs, human erythema, photographic blackening, reduction of methylene blue and quinone and the oxidation reduction of carcinomatous serum, all methods employed by various previous investigators. The present investigators' results are in favour of there being no selective chemical, biological or seriological reaction for X-rays of shorter wave-length than 0·1 Å, although there is a somewhat stronger reaction of the harder rays for the same quantity of energy absorbed. B. J. L.

*4014. **Portable Direct-Reading X-Ray Dosage-Rate Meter. G. W. C. Kaye and G. E. Bell.** *Brit. J. of Radiology,* 8. *pp.* 467–476, *Aug.,* 1935.—A direct reading meter for measuring X-ray dosage rates has been developed which is both robust and portable. Its operation depends essentially on the direct amplification of the ionisation current in a thimble chamber by the use of an "electrometer" type of valve, the current amplification being of the order of a million. For measurements in direct X-ray beams a small cellophane chamber with a range from 0 to about 2 röntgens (r) per minute is suitable. For the measurement of weak "stray" radiation a large paper chamber is provided, the total range in this case being from 0 to about four times the "tolerance" dose of 10^{-5} r per second. This chamber may also be used for measuring weak γ-radiation. AUTHORS.

***4015. Simple and Compact X-Ray Meter. C. N. Rocky.** *Brit. J. of Radiology*, 8. *pp.* 481–486, *Aug.*, 1935.—A new, simplified form of direct reading dosage-rate meter is described, based upon the principle of the measurement of the potential drop in a resistance through which the ionisation current is led. The measurement is carried out by means of a novel type of electrometer. Special means have been taken to shield the electrometer system, so that the important insulators are not stressed with more than 4 volts. The necessary potentials for the instrument are drawn directly from any a.c. supply and a stabiliser of the neon type is fitted, which keeps the internal voltages constant to ± 0·2 %. Great convenience in practical use is claimed for the flexible design of the standard ionisation chamber rod. AUTHOR.

4016. Measurement of Radon Implants. P. A. Macdonald and E. M. Campbell. *Rev. Sci. Instruments*, 6. *pp.* 212–214, *Aug.*, 1935.—A rapid method of measuring sources of ionisation is described. The ionising agent is moved relative to the ionisation chamber and the change in the ionisation current is treated as if it were half a wave of an alternating current. This wave is amplified by means of an a.c. thermionic amplifier. The sensitivity of the apparatus is of the order of 10^{-12} A/mm. and it is capable of measuring radon implants at the rate of three a minute. AUTHORS.

OSCILLATIONS.

4017. New Method of Producing Short, Undamped Waves of Great Intensity. A. Arsenjewa-Heil and O. Heil. *Zeits. f. Physik*, 95. 11–12. *pp.* 752–762, *July* 12, 1935.—The oscillating energy is coupled with an electron ray, without the oscillating electrode being struck by this ray. If the electron ray has an effective energy of 400 W, the maximum amount of this energy which is changed into oscillating energy is 35 %, but usually only 25 %, *i.e.*, 100 W, is used. Theory indicates the region for stability, where the wave may be modulated and how the damping may be kept constant. H. M. B.

4018. Voltage-Distribution and Electron Transit-Time in the Planar Diode. R. Cockburn. *Phys. Soc., Proc.* 47. *pp.* 810–817, *Sept.* 1, 1935.—The general solution for the voltage-distribution in a diode with plane electrodes is derived from the differential equation of motion of the electrons, the effect of initial velocities being treated approximately. The solution is applicable for currents from zero up to that value which reduces the kathode field to zero. The general solution for electron transit-time is then derived. It is found that increase of space charge increases the transit-time, most of this increase occurring just before the kathode field is reduced to zero. The effect of initial velocities of emission is to reduce the transit-time, the amount of the reduction increasing as space charge increases, so that the sharp increase of transit-time due to the accumulation of space charge becomes less apparent for large initial velocities. The application of the theory to electron oscillations is discussed. AUTHOR.

4019. Electric Properties of a Blocking Layer on Lead Sulphide. W. Schade. *Phys. Zeits.* 36. *pp.* 499–508, *July* 15, 1935.—The normal effect of a Pt point on a PbS surface, for oscillating currents of low potential, is to allow the positive current to flow from point to plate. As the oscillating potential is increased, the rectified current reaches a maximum, then decreases and is finally reversed. Characteristic curves are obtained by plotting detector currents against exciting voltage or amperage, and by a kathode-ray oscillograph having one pair of deflecting plates fed by the voltage in the detector circuit and the other pair giving a suitable time-base. Theory is given to show that the effect is due to the movement of electrons in the blocking layer between the point and the surface.
H. M. B.

***4020. Automatic Frequency Comparator. N. F. Astbury.** *Journ. Sci. Instruments,* 12. *pp.* 245–249, *Aug.,* 1935.—An arrangement is described by means of which the beats occurring between two frequencies are automatically counted and timed. The apparatus is at present used to compare frequencies of 100 and 1000 ∼, beats being obtained between the latter and the 10th harmonic of the former, but it is generally adaptable. The counting and timing circuit, a feature of which is the accurate and " fool-proof " starting and stopping arrangement, can be used separately to time any recurring event. AUTHOR.

***4021. Mechanical Model of Coupled Electrical Circuits. E. L. Chaffee.** *Rev. Sci. Instruments,* 6. *pp.* 231–238, *Aug.,* 1935.—A mechanical model of two vibrators with inertia coupling is shown to be theoretically analogous to magnetically-coupled electrical circuits. The model is arranged to be subjected to a sinusoidal impressed force and photographic reproductions are given of the vibrations recorded by the vibrators, free, coupled and under the influence of the external force. Special notice is taken of the damping effects and a diagram of connections of a valve circuit, in which the primary is self exciting, shows an application of the mechanical model to the elucidation of electrical effects. H. M. B.

See also Abstract 3998.

PHOTOELECTRICITY.

4022. Photoelectronic Effect of Incandescent Metals. C. M. I. Vercelli. *Accad. Sci. Tornic, Atti,* 70. 3. *pp.* 462–471, 1934–1935.—The theory of the photoelectronic effect of surfaces (Hallwachs effect), put forward by Fowler, leads to the confirmation that the photo-thermo-electronic effect observed by Deaglio is a Hallwachs effect produced at high temperature by light of frequency notably lower than the photoelectronic frequency limit. J. J. S.

4023. Spectral Distribution of the External Photoelectric Effect. F. Hlučka. *Zeits. f. Physik,* 95. 7–8. *pp.* 486–498, *June* 26, 1935.—An attempt to survey the existing data with a view to drawing conclusions as to the relations between the photoelectric emission and the spectral distribution of the light falling on the kathode. The following conclusions are drawn: (1) The photoelectrons are liberated from a very thin layer probably very much less than the wave-length of the light used. (2) The periodic photoelectric effect on these layers leads to the idea that the distribution of light on the kathode determines the energy changes. (3) The connection between photo-current and angle of incidence is explicable in terms of absorption. (4) The maxima in the photoelectric current-frequency curves remain fixed for all possible variations—only the intensity varies. As regards the selection effect the result pointed out in a previous paper that this is connected with optical characteristics of the surface is again confirmed. There is however a great deal of experimental work which is at present quite inexplicable. J. E.

4024. Temperature Dependence of the Photoelectric Effect. K. Mitchell. *Cambridge Phil. Soc., Proc.* 31. *pp.* 416–428, *July*, 1935.—The temperature dependence of the photoelectric effect with the image field is discussed, the result obtained agreeing with Fowler's T^2 law near the threshold. Fowler's $T^{\frac{3}{2}}$ law is discussed, and is shown to rest upon a mistake in the normalisation of the free wave functions. The two methods of analysing experimental results due to Fowler and du Bridge are also discussed, and it is shown that in general the latter should give the more reliable results. [See Abstract 4361 (1934).] AUTHOR.

4025. Velocity Distribution of Photoelectrons in Al Films. E. Wasser. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 532–546, 1935. *In German.*—The energy distribution of the photoelectrons liberated from Al films was investigated for different thicknesses of the metal and for different wave-lengths of the exciting light [see Abstract 3950 (1934)]. Conclusions are formed concerning the processes of liberation of the electrons, and the distribution of the eigenvalues of the electrons in the metal. D. H. F.

4026. Spectral Photoelectric Sensitivity of Composite Photo-Kathodes. W. Kluge. *Zeits. f. Physik,* 95. 11–12. *pp.* 734–746, *July* 12, 1935.—The spectral photoelectric sensitivities of photo-kathodes of the type T–M_2O–M in which T, the carrier metal, was successively Ag, Cu, Ni and Au, and M was successively Na, K, Rb and Cs are investigated over the range of wave-lengths 200–1100 mμ. The spectral curves are band-like in character. The long-wave maximum is interpreted, in accordance with Gudden and Pohl's theory, as an optical absorption band due to superficially adsorbed alkali atoms. Its spectral position is determined by the so-called intermediate layer, *i.e.*, that composed of the alkali metal oxide and the carrier metal distributed therein. No long-wave maxima were found in the case of the kathodes Ni–Cs_2O–Cs and Au–Cs_2O–Cs. In the case of the kathode Ag–Cs_2O–Cs the long-wave maximum occurred between 700 and 780 mμ; in the case of Cu–Cs_2O–Cs it occurred between 630 and 660 mμ. The short-wave maxima invariably occurred between 350–370 mμ and 290–300 mμ. The short-wave selective effect is associated with the alkali metal itself. In the case of the kathode Ag–Cs_2O–C, which was alone examined down to 227 mμ, a third short-wave maximum selective effect was found at 240 mμ. J. S. G. T.

4027. Amplification of Photoelectric Currents by Secondary Emission. F. M. Penning and A. A. Kruithof. *Physica,* 2. *pp.* 793–804, *Aug.*, 1935. *In German.*—In vacuum photo-cells the current from the kathode (*K*) may be amplified about 7 times by secondary emission from a third electrode (*B*) of the same material as the kathode. For the coefficient of secondary emission (δ) values up to 9 were found; there was no well-defined correlation between δ and the photoelectric sensibility. These secondary-emission cells show a practically constant dynamic response to light variations up to at least 20 kc. The relative value of the shot effect (noise to signal ratio) is higher than in vacuum cells of the same photo-current, but smaller than in gasfilled cells with the same photo-current and the same amplification; probably it decreases with increasing energy of the primary electrons. With gasfilled secondary-emission cells a large amplification may be reached at very low gas pressures; this effect is ascribed to the to and fro movement of the secondary electrons. AUTHORS.

4028. Photo- and Dark-Conductivity of Cu_2O. D. Nasledow and L. Nemenow. *Phys. Zeits. d. Sowjetunion,* 7. 5–6. *pp.* 513–531, 1935. *In German.*—The authors have investigated, at liquid-air temperature, the possibility of the passage of photoelectrons through the non-illuminated part of a polycrystalline specimen of Cu_2O, as well as the diffusion of electrons. These phenomena were absent, probably owing to the presence of centres of inhomogeneity, resulting in the life-periods of the electrons being very short. Polarisation under high potentials was observed. The existence of potential discontinuities at the Cu_2O metal boundary was deduced at liquid air temperature. These discontinuities disappeared under illumination, when the potential distribution became linear. The presence of a poorly conducting boundary layer is deduced, of which the mode of formation is obscure. D. H. F.

4029. Direction of Emission of Photoelectrons by X-Rays in Copper-Oxide Photo-Cells. W. M. Tutschkewitsch. *Phys. Zeits. d. Sowjetunion,* 7. 3. *pp.* 329–335, 1935. *In German.*—It is shown that, under the action of X-rays the electrons move from the copper oxide to the copper as in the case of visible light. The direction of irradiation is immaterial, and it is concluded that the origin of the photoelectric e.m.f, is the same both for X-rays and for light. G. E. B.

PIEZOELECTRICITY.

4030. Dilatations in Rochelle Salt. I. Vigness. *Phys. Rev.* 48. *pp.* 198–202, *Aug.* 1, 1935.—The inverse piezoelectric effect of Rochelle salt was studied by means of mechanical dilatometers. In general equal and opposite voltages do not give rise to equal and opposite strains. This is attributed to a permanent electric polarisation within the crystal. The time constants calculated from oscillograms of the deformation of a crystal vary from zero at the critical temperatures to a maximum approximately midway between them. The thermal expansion along the three crystallographic axes shows no discontinuities, but a change in the rate of expansion occurs at the critical temperature (24° C.) for the *b* and *c* axes. P. V.

4031. Electrical Twinning of Quartz. L. Essen. *Journ. Sci. Instruments,* 12. *pp.* 256–257, *Aug.*, 1935.—Natural quartz crystal may be electrically twinned though the fact may not be detectable by optical methods. To ensure that a crystal is satisfactory as an electrical resonator or oscillator, it is necessary to examine it in detail. Examples are given of the type of results which may be obtained from defective rectangular and annular crystals. AUTHOR.

See also Abstracts 3734, 3752.

THERMIONICS.

4032. Influence of Impurities in the Core-Metal on the Thermionic Emission from Oxide-Coated Nickel. M. Benjamin. *Phil. Mag.* 20. *pp.* 1–24, *July,* 1935.—The commoner metallic impurities have been added in turn to a pure nickel, and the emission from the oxide-coated cores compared. It is found that these additions can profoundly affect the emission. An explanation put forward is that the amount of Ba in the coating is dependent on the reducing power of the additive. This theory is supported by the results obtained when the addition is a powerful reducing agent such as Al. It is found, also, that at very low temperatures non-saturation of the emission occurs, and that the critical temperature depends on the nature of the additive. The results obtained are explained by the theories of the mechanism of emission, due to Becker and Sears, and Fowler and Wilson, which regard the coating as a semi-electronic conductor whose conductivities and emission depend on the concentration of Ba in the coating. AUTHOR.

4033. Relation Between Electronic and Ionic Current from a Hot Kathode in Hg Vapour. S. Gvosdover. *Phys. Zeits. d. Sowjetunion*, 7. 3. *pp.* 274–291, 1935. *In German.*—The ratio of electron current to ionic current in the neighbourhood of an oxide kathode in Hg vapour is measured and two different types of characteristic are distinguished. If the kathode is at zero potential, the ratio of electron to ionic current is between 395 and 435. When there is a field in the kathode region, the magnitude of the emission current is determined by the Schottky effect and by the microstructure of the surface of the kathode; this current may exceed the saturation current given by the same kathode *in vacuo* but the ratio of electronic to ionic current is smaller. A theoretical explanation of the observed effects is suggested. H. J. H. S.

See also Abstract 3820.

THERMOELECTRICITY.

***4034. Peltier Effect Demonstration Apparatus. H. Čech.** *Phys. Zeits.* 36. *pp.* 415–416, *June* 1, 1935.—A simple and compact form of apparatus is described by which the Peltier effect may readily be demonstrated to a large audience. The advantage of the apparatus is that, owing to the design of the Sb-Bi junctions, a current of the order of 20 amperes may be passed and this gives rise to a large response on a differential thermoscope. The whole apparatus may be mounted on an optical bench so that the differential manometer may be projected. H. J. H. S.

4035. Thermo-E.M.F.s at Temperatures from 2·5 to 17·5° K. W. H. Keesom and C. J. Matthijs. *K. Onnes Lab. Leiden, Comm. No.* 238*b*. *Physica*, 2. *pp.* 623–632, *July*, 1935. *In English.*—Thermo-e.m.f.s against a silver-alloy normal were measured down to the temperatures from 2·5 to 17·5° K. for an alloy of Ag with Au and for Au with small quantities of Fe, Co, Ni, Mn or Cr respectively. [See also Abstract 3392 (1932).] AUTHORS.

4036. Thermo-E.M.F.s in Salt Crystals with Colour Centres. O. Stasiw. *Göttingen Nachrichten, Fachgruppe II.* 1. 17. *pp.* 199–202, 1935.—With a view to obtaining information upon the mechanism of the production of thermoelectric e.m.f. in metals, experiments are carried out upon junctions between KCl crystals with and without colour centres. The two junctions are kept at different temperatures (under 700° C. in order to restrict the mobility of the positive charges) and p.d.s up to 0·4 volt are observed, the colder junction being negative. The mobility of the positive charges is calculated from the variation of the thermo-e.m.f. with the temperature difference between the junctions. L. A. W.